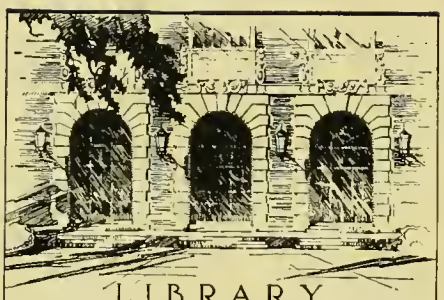

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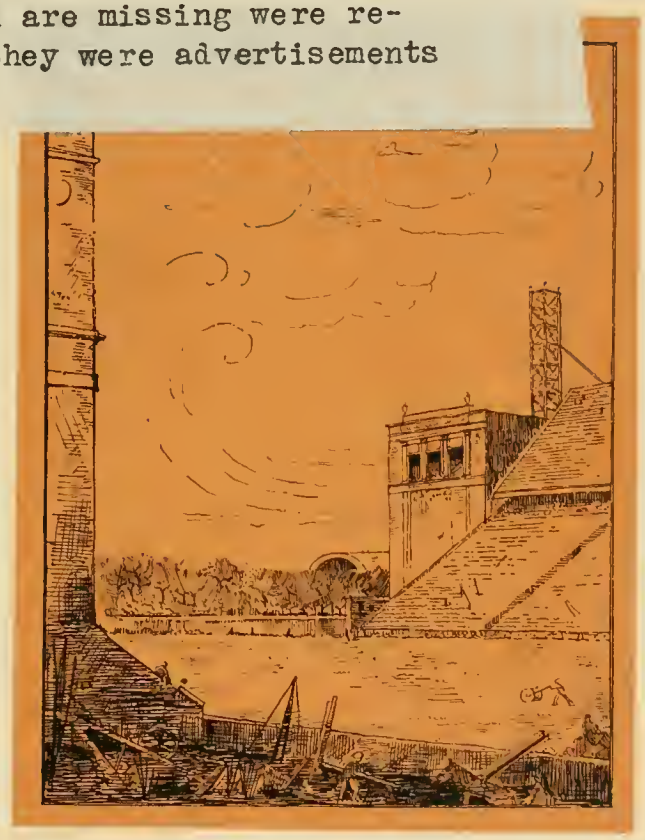

November
1923

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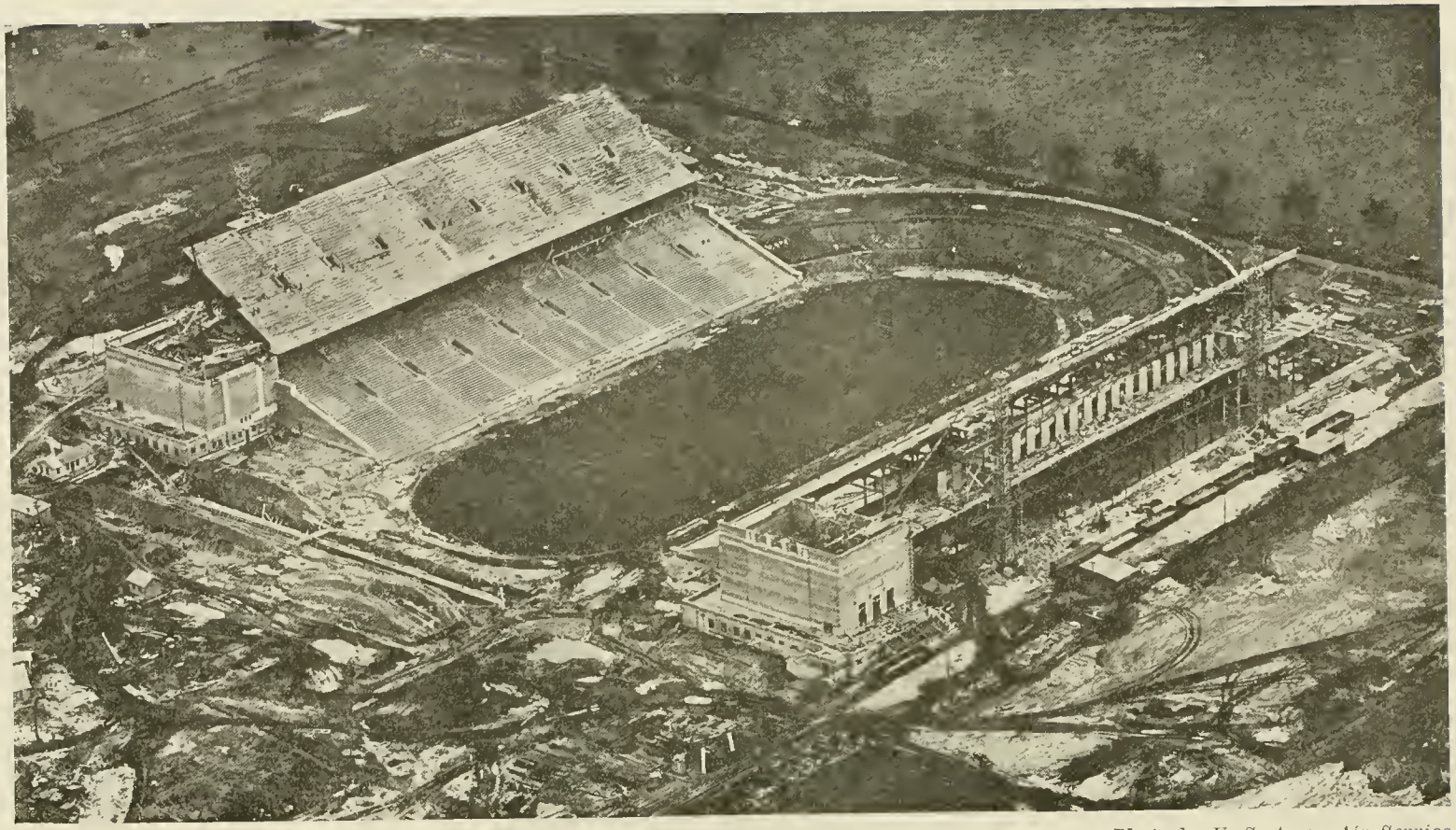


—Photo by U. S. Army Air Service

University of Illinois Memorial Stadium—October, 1923

University of Illinois Stadium

H. J. Burt, c.e., '96

One great consideration governing the design of the Memorial Stadium was that the seats should be as nearly equal in value as possible to make them. Viewing the field from all of the extreme portions of the Stadium in its present condition indicates that the desired result has been accomplished. It is true that the seats are not quite of equal value, but all of them are good. Seats which are at a low elevation making it somewhat difficult to follow the moves of the individual players have the advantage of nearness; seats which are farther away and at a higher elevation give more nearly a bird's eye view and make it easier to follow the players. In arranging the seats it was necessary to so adjust the successive steps of the stands as to get a minimum interference of sight lines consistent with the number of rows of seats. To get the best theoretical results each successive riser must be higher than the one immediately in front of it. The basis used is that a spectator in any seat shall be able to see the arena level at a fixed line outside the edge of the playing field and be able to see this fixed line over the head and hat of a person of average height sitting on the 2nd row toward the front.

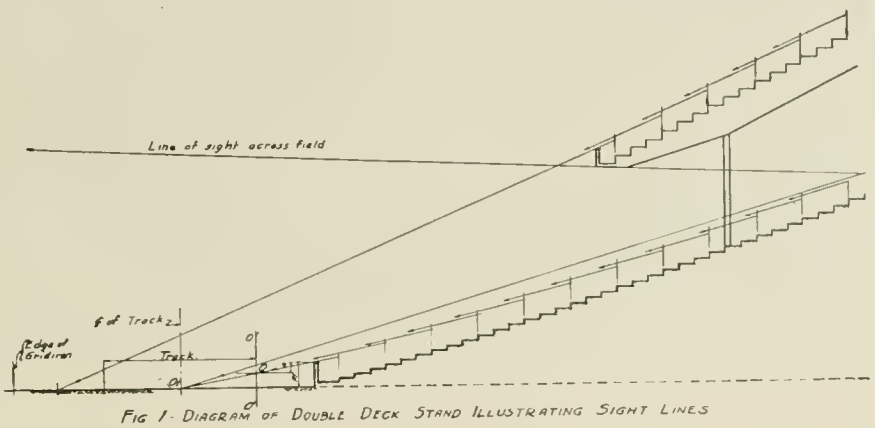


Fig 1- Diagram of Double Deck Stand Illustrating Sight Lines

It is assumed that the spectator, by slightly shifting his position, can see past the person sitting immediately in front of him. On this basis this spectator has a clear and unobstructed view of the entire field. Both the main stands and the balconies of the Illinois Stadium are laid out on this basis except that the sight line from the balcony strikes the arena farther out than the sight line from the main stand but nevertheless it gives a clear view of the side lines of the playing field from every seat.

In a stand having a balcony it is inevitable that the structural supports for the balcony shall interfere with sight lines from the rear seats of the main stand. The framework in this Stadium is so arranged that the interference is reduced to an absolute minimum. In each stand there are only eight columns, which give this interference. They are spaced 46 feet apart and are located two-thirds of the way back from the front of the main stand so that only the rear third of the seats are affected by them. For any given seat only two columns will interfere with the view of the field and by slight movement sidewise the spectator can see every inch of the playing field. It is believed, in the tense interest of the game, that a spectator in the rear part of the stand will not be conscious of the presence of these posts. The Illinois Stadium is one of the few large stadia, designed especially for football, to have an upper deck or balcony. The present state of the construction is sufficient to demonstrate the value of the balcony seats. The elevation gives a sense of nearness, which more than offsets the distance, and the angle of sight is such that the movements of the individual players can be followed easily.

The Stadium is located upon a tract of fifty acres of land lying southwest of the armory and drill ground. The structure occupies about ten acres leaving forty acres available for approaches, practice fields, and other athletic uses. The site is slightly rolling with a general slope from east to west. The elevation of the arena was established about 10 feet below the average ground level. This necessitated the excavation of more than 100,000 cubic yards of earth, which is being used to grade the area outside of the Stadium into terraces and wide level spaces for play grounds. The amount of excavated material is just about the amount required for this grading. The elevation of the arena was established at this low level so that the structure might not appear too high above the finished grade, also for the purpose of furnishing the dirt for grading as mentioned. The general level of this ground is high enough so that there has been no difficulty in obtaining satisfactory drainage from the play-

ing field into the drainage system of Champaign.

The general appearance of the finished structure is shown in Fig. 2, which is a reproduction of the architects' perspective. The plan shown in Fig. 3, also will assist in understanding the layout. The Stadium is divided into two separate sections, the east and the west stands, which with some minor exceptions are identical. At the north and south ends of each stand is a tower containing the ramps leading to the balcony. The back part of each stand is closed in with a brick wall having stone trimmings and in the upper part of this is the colonnade of Memorial Columns. The ramp towers also are built of brick with Bedford stone trimmings. At the south end the two ramp towers are connected by an earth embankment, semi-circular in form, retained on its south side by a brick wall. This forms a terrace on which temporary seats can be erected if needed. North of the arena there is an enclosing brick wall connecting to the corners of the ramp towers with curved wing walls.

FIGURE 2—ARTIST'S DRAWING OF STADIUM

The arena is laid out to accommodate a football field and a running track. It was made as narrow as practicable for serving these purposes. The gridiron is 160 feet wide. On each side of this is a safety zone between the gridiron and the track of 16 feet. The width of the track is 25 feet and there is a space of 4 feet between the edge of the track and the curb wall. This makes the total width of the arena 250 feet. Its length is extended at the north some distance beyond the Stadium to provide sufficient space for the quarter mile track and two 220 yard straight-away tracks. The length of the space occupied by the seats is 414 feet. The length of the gridiron is 300 feet, thus the seats extend only 57 feet beyond each end of the gridiron so that all of the seats are within easy seeing distance. The extreme length of the stands including the ramp towers is 547 feet. The width of each stand from the back wall to the front curb line is a little less than 200 feet. The widths of the two stands added to the width of the arena makes the total width across the structure approximately 650 feet.

The cross section of one of the stands is shown in Fig. 4. This cross section gives a clear idea of the relation of the main deck and the balcony to the arena and the slopes of the stands. From this section it will be noted that the arena elevation is marked 0.0. The elevation of the outside approaches is 18 feet 6 inches. The main deck rises from elevation 1 foot 0 inches to elevation 62 feet 3 3-4 inches. The elevation of the balcony rises from 57 feet 3 1-2 inches to 109 feet 4 inches. This drawing emphasizes the difference in the slopes of the main stand and the balcony, which has been mentioned in connection with the sight lines. The risers on the main deck increase in height progressively from the bottom to the top, the lowest one being 8 inches and the highest 11 1-4 inches. On the upper deck they increase from 14 3-4 inches at the bottom to 17 inches at the top. The treads are all 2 feet 2 inches wide.

As the heights of risers are not comfortable for sitting, wooden seats are provided. These are blocked up so that they have a uniform height above the treads of 18 inches, which is the normal height of a comfortable seat. These wooden seats are made by bolting blocks to the concrete deck and on these blocks are three lines of 2 in. x 4 in. cypress planks. This seat material was selected for its durability. It is high grade red cypress from the swamps of Louisiana. The surfaces are all dressed smooth and the edges chamfered. Before being put in place they were painted with two coats of white lead paint. It is expected that these seats will be almost as durable as the remainder of the structure.

The construction materials used in the stands are structural steel and reinforced concrete. The decks are entirely of reinforced concrete. The lower third of the main deck is supported on reinforced concrete beams and girders. The remainder of the main deck, the balcony and the collonnade are supported on structural steel framing. All floors and ramps are of reinforced concrete. The enclosing

walls, as previously mentioned, are made of brick with Bedford stone trimmings. Inasmuch as the danger from fire is practically nothing the structural steel work has not been encased in concrete but is left exposed and painted a suitable color.

An incidental feature of each stand is the Great Hall, shown in Fig. 4. This is an open space 50 feet wide and 414 feet long. It has a clear height of 30 feet and will be available for indoor sports of various kinds. Access to the main stand is through ten lower and ten upper portals. The approaches to these portals are across the Great Hall, thence directly to the lower portals at the same level as the floor of the hall, and to the upper portals by means of ramps. No stairways are used in the approaches to the decks but steps are required, of course, on the decks themselves for going up and down from the portals. Access to the balcony is had by means of three ramps in each of the four ramp towers, each ramp leading to a separate portal of the balcony. These portals are at approximately the midheight of the balcony. Toilet rooms are provided in convenient locations under the main deck and under the balcony.

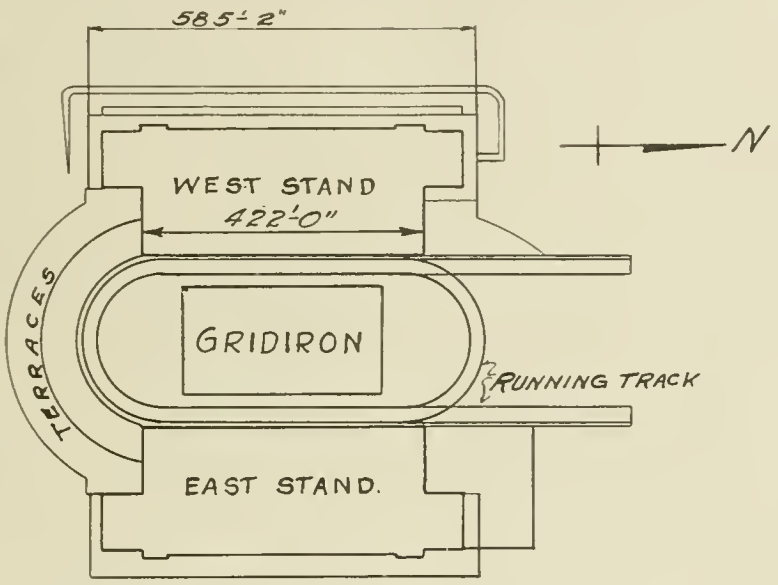


FIGURE 3—GENERAL PLAN OF STADIUM

At the top of, and back of, the main deck at elevation 62 feet 3 3-4 inches is a promenade extending through a stately colonnade. Each row consists of fifty columns making a total of 200. These columns constitute the Memorial feature of the Stadium. On each of them will be carved the name of an Illinois boy who sacrificed his life in the World War. In addition to the name there will be his class year and the army organization to which he belonged. At the end of one of the colonnades there will be a bronze tablet recording the names of those who contributed specifically to the Memorial feature of the Stadium.

In order to protect the Stadium from deterioration, due to changes in temperature and moisture, the space between ramp towers has been divided into nine sections which are built independently of each other separated by eight transverse joints. In addition to these the lower deck is divided into three sections by two longitudinal joints. These joints subdivide the structure into units 46 feet long and varying in width from 50 feet to 90 feet, which are independent of one another and free to expand and contract with changes in moisture and temperature conditions. Structures of this kind are exposed to the extremes of weather conditions and experience has shown that they are subject to deterioration unless suitable provision is made for the resulting expansion and contraction. A number of existing structures show serious damage from lack of such provision. The loads used in designing the structure consist of the actual weight of the construction materials and an imposed load of 100 pounds per square foot on the decks and on all ramps and walks. This imposed load is approximately 2 times the actual weight of the number of people who can occupy the seats in the stands. The excess is allowed as a provision for impact or moving loads. The actual seating capacity of the Stadium according to the October issue of "Memorial Stadium Notes" is 55,524 persons, as follows:

East Stand:		*West Stand:*	
Lower deck	17,659	Lower deck	17,659
Balcony	9,643	Balcony	9,411
Boxes	516	Boxes	636
	27,818		27,706

Total, 55,524

Temporary seats can be placed at the north and south ends of the field to provide, if needed, for several thousand additional spectators. The approaches, ramps, and portals are so ample that this large number of people can be admitted and discharged in a very brief time with no crowding and very little confusion. At the time this article is published the construction has progressed as shown in the frontispiece. All of the seats in the east and west stands are complete and ready for use. The north ramp towers are sufficiently completed to

serve for access to the balconies. The south ramp towers, the main enclosing walls and the colonnades are not yet built. These unfinished items will require nearly a year for their completion. Meanwhile the Stadium has been put into service by the great Homecoming game, which was played November 3 and won by Illinois.

The plans for the Stadium were made by Holabird & Roche, Architects, who also are Architects for the Grant Park Stadium in Chicago. F. B. Long, '88, and R. M. Cabeen, '09, assisted in developing the general scheme. The structural design was made under the direction of H. J. Burt, '96, assisted by B. M. Thornd, '18. The late J. B. Blake, '88, supervised the design of the drainage, plumbing, lighting and heating. W. A. Slater, '06, who is an expert on concrete was the direct representative of the Building Committee on the construction, co-operating with Mr. Muray B. Augus, Superintendent for Holabird & Roche.

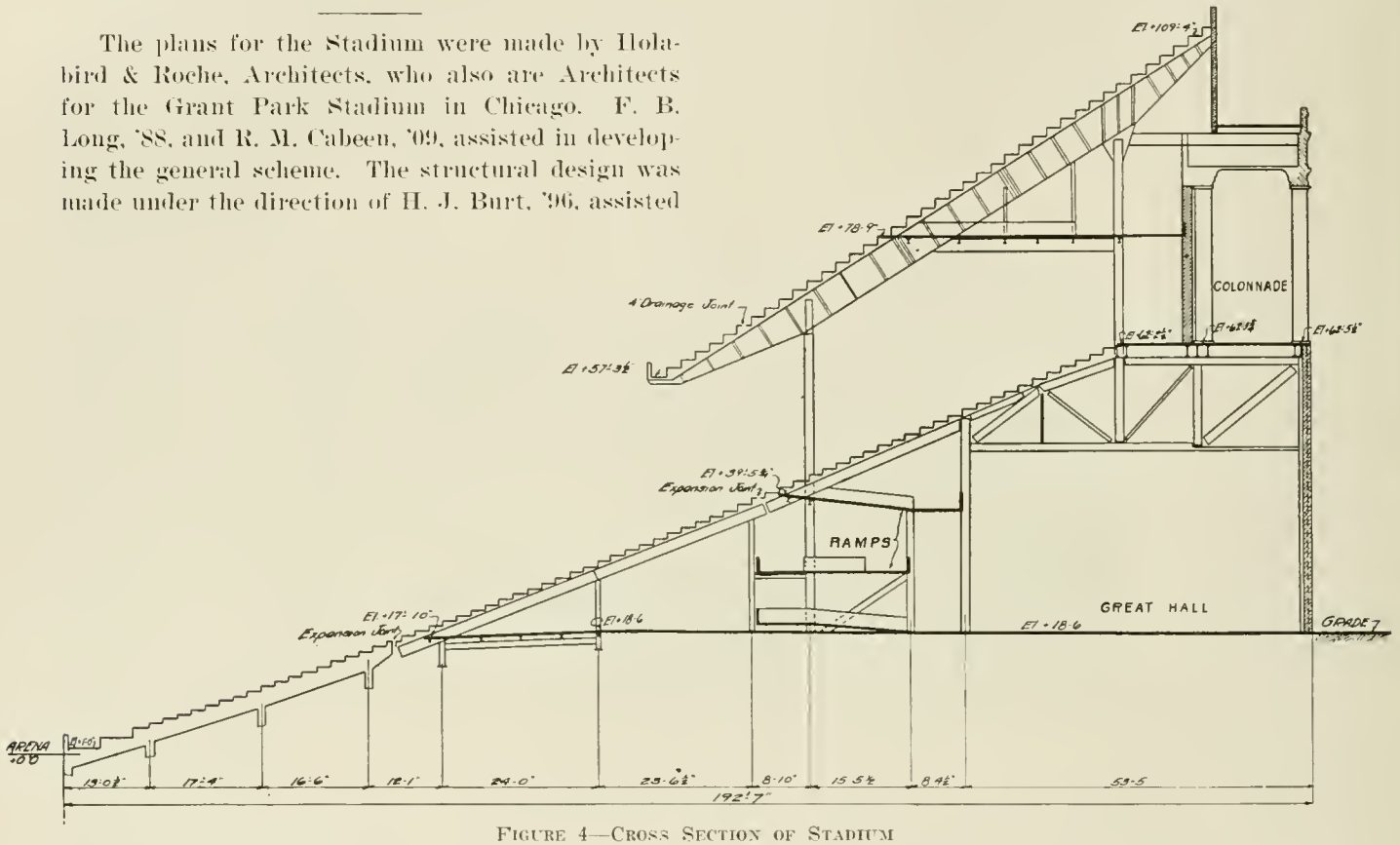


FIGURE 4—CROSS SECTION OF STADIUM

THE STADIUM

BLISS SEYMOUR '21

Like autumn leaves that flutter and grow still,
The rooters hush and sink into their places,
The gripping moment over. In their faces,
(Young faces, burning with the combat's thrill,
And yet quite strangely old and sober-eyed)—
No thought dares enter of another game
When killing and not scoring was their aim,
And all of them fought on the selfsame side.

Yet we remember them, and all those others
Who lie in France. The Stadium's grey stones
Forbid us to forget; the shadow tones
Across the field make, living and dead, brothers.
And in the shouting we recall a day
When death came to the loser in the play.

—REPRINTED FROM ILLINI POETRY.

Tests of Welded Rail Joints

H. R. Lorsch, r.e.e., '24

The problem as to which type of rail joint is best suited to street railway practice has long confronted the engineers of that profession. There are at present a large variety of rail joints in use, varying greatly in design and method of fastening, as well as in material. None of these have as yet been accepted as having a decided advantage over the others. To that end a series of tests is now being conducted by a committee on welded rail joints, made up from the American Electric Railway Association and the American Bureau of Welding, in co-operation with the National Research Council.

The problem on which this committee is working is not only of vital interest to the traction companies themselves, but it is also of great economic importance to the public that these companies serve. Failure of joints in street railway tracks makes it necessary to remove the pavement and repair the tracks with delays to traffic and at considerable expense. If a joint could be developed having a life equal to the rail itself, the cost of maintenance would be greatly reduced.

It is obviously impossible to obtain information, that will permit the selection of the superior type of joint, from service tests in different cities, conducted under widely varying conditions. The committee, therefore, requested certain reliable institutions to conduct the tests in a strictly scientific manner. Conductivity and tensile strength tests are being made by the Bureau of Standards, bend tests by Purdue University, and impact or drop tests by the University of Illinois. Rotary service tests will be conducted in the vicinity of Washington, D. C. One of the very significant points of the investigation is the fact that the test specimens were constructed under conditions identical to those which they would have been subjected to, had they been intended for actual service. The rail sections were laid out and welded together on city streets and were then cut into the desired lengths with hack saws, and shipped to their various destinations.

There are three general methods of track welding which are in common use today. The oldest of these is the cast weld. In this construction, the rail ends are joined by a mass of cast iron surrounding them. The iron is melted at a high temperature and poured into iron moulds around the rail ends. This chills the outside surface of the cast metal, so that the interior has its temperature raised to a welding heat, and an actual weld is made with the steel of the rails.

Another method of rail welding is by use of "Thermit." This is a patented mixture consisting of metallic aluminum and iron oxide in proper proportions, with other ingredients added to obtain a metal of the required composition. "Thermit" is supplied in the form of a powder which, when ignited, undergoes a chemical reaction, the aluminum combining with the oxygen to produce alumina and metallic iron at a high temperature. The powder is placed in crucibles directly above the rail joints, the latter having been previously heated by some external means. The mixture is ignited, and when the reaction is complete the molten iron is tapped into moulds around the rail ends. The weld produced is not unlike the cast weld; but the metal is of a different character. The temperature of the molten metal is much higher than in the cast weld, and the amount of metal required is considerably less.

The third type, the electric weld, may be divided into two distinct methods. In the first, which has the widest application, joint plates are welded to the side of the rail ends by the incandescent or resistance process. The current is taken from the contact line, converted to alternating current by a rotary converter or motor generator set, and changed to a low potential through a stationary transformer, whose secondary winding consists of a single turn of heavy bar and terminates in jaws which are placed against the parts to be welded. The resistance in the secondary circuit is practically all concentrated between the rail and the joint plate; hence a considerable amount of heat is generated there, and the temperature is raised to the welding point. By applying a sufficient pressure to the jaws, an actual union of the metals is obtained. The entire section is not welded, but two or three places on the end of each rail suffice to make a very firm connection.

The second system of electric welding uses the arc method. Here the rail is made one terminal of the electric circuit, and a rod of carbon the other. The heat generated when an arc is struck between the carbon electrode and the rail is sufficient to raise the metal to a welding temperature, and even to melt it. Thus plates may be welded to the rail, forming a permanent joint.

Of the four methods mentioned, the "Thermit"

process requires the least expensive equipment. The arc, the cast and the resistance weld require more expensive apparatus in the order named. The cost of making joints varies from about $2.75 for cast welds to $4.50 for "Thermit" and $6.00 for resistance welds. All of the above mentioned methods of welding rails were used in preparing the test specimens. Joint plates in a variety of sizes and shapes were used and thus a large number of entirely different joints were produced.

The conductivity of rail joints is a matter of great importance. Poor conductivity not only gives rise to large energy losses and large voltage drops, but it also greatly increases the magnitude of stray currents, and leakage from tracks to earth, thereby rendering the electrolysis problem more serious. A large amount of work has already been done on the conductivity of rail joints of all types. It has been shown that, if welded joints have sufficient mechanical strength, their electrical conductivity will also be satisfactory. On the other hand, if they are mechanically defective, welded joints may constitute what is virtually an open circuit. While this tends to lessen the importance of electrical tests on laboratory specimens, it increases the importance of the various mechanical tests.

The tensile strength of the various types of rail joints measures their resistance to the stresses caused by expansion and contraction of the rail due to temperature changes. The rails are being tested in a 1,150,000 pound Emery testing machine at the Bureau of Standards. The principal difficulty in making these tests is in holding the rail in the jaws of the testing machine. These tests afford, besides the strength of the joint, data on the character of the failure and will probably result in improvements in the joints.

Of fully equal importance is the strength of the welded joint with regard to resistance to transverse bending. A transverse test of a full rail section with the joint at mid-length can very readily be made in a laboratory with fully equipped test apparatus. Such a test will furnish detailed information on the strength and method of failure of the joint. The test specimen is relatively simple and can be tested by the application of a vertical load at the center of the joint with the rail specimen supported at each end.

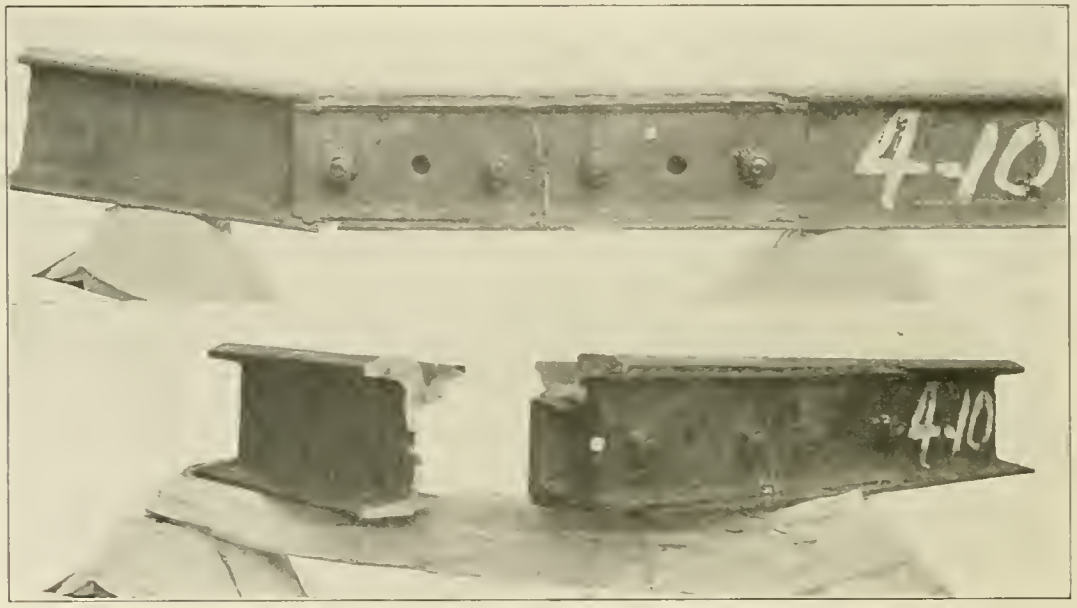


Fig. 1—Specimen at Two Stages in Test

To avoid the great expense of testing joints in tracks under traffic, and in order to secure actual service test data in the shortest possible time, a circular track has been proposed upon which a car can be operated continuously. In this way joints of many different kinds can be subjected to the same service conditions and results obtained which should be practically identical with those found for the usual conditions. This test will be an extremely important part of the test program.

The impact or drop tests have been conducted by the Railway Engineering Department of the University of Illinois. As the stresses in a rail joint are greatly increased by the impact of the cars due to flat wheels and worn rails, and the resistance of steel to impact stresses can not be determined by static tests, the experiments conducted at the University were very essential.

The test machine used was similar to the Master Car Builder's drop machine. The apparatus has a

concrete foundation on which is mounted a cast iron base. On this the uprights are bolted. These allow the hammer or tup to fall fifty feet. Borne on springs and resting on the base is an anvil, weighing twenty thousand pounds. The rail joints were laid upon supports directly under the tup. The latter weighs one ton and is raised by means of a hoist. It is automatically tripped at various heights. Starting at six inches, the drops were taken in six increments up to a height of three feet, and thence one foot increments, until the failure of the specimen occurred.

The following table is a summary of the test results on several of the welded joints:

Height of Drop	Deflec'n Perm't set (in.)	Remarks
Seam weld, 5-11		
0.5	0	Rail cracked at end of joint plates.
1.0	x	Rail broke at end of joint plates.
Thermit weld, 5-23		
0.5	0	
1.0	x	Rail broke at joint.
Cast iron joint, 18-11		
0.5	0	
1.0	.08	
1.5	.25	No sign of failure.
2.0	x	Rail broke at joint.
Butt weld, 11-24		
0.5	0	
1.0	.03	
1.5	.08	
2.0	.18	No sign of failure.
2.5	x	Broke at joint.
Seam weld, 15-8		
0.5	.13	Slight crack in weld at base.
1.0	.17	Slight crack as above.
1.5	.27	1-8 in. crack at base of rail.
2.0	.40	1-4 in. crack at base of rail.
2.5	.69	1-4 in. crack as above.
3.0	.89	Cracked along seam on flange side also.
4.0	1.37	1-2 in. break at base.
5.0	2.08	Weld broken along seam on one side.
6.0	2.82	Same as above.
7.0	4.23	2 1-4 in. opening at base of joint.
8.0	x	One side plate broken,rail loose between plates.
Seam weld, 4-10		
0.5	.16	Very slight crack at rail joint.
1.0	.32	Rail separated at joint, .115 in. crack along seam at base.
1.5	.65	
2.0	1.17	Rail cracked along seam.
2.5	2.12	Two bolts sheared. Weld cracked and separated.
3.0	x	Rail broke at joint.

x in second column indicates that the rail joint broke.

Figure one, shows two stages in the test on specimen 4-10, also a seam weld. The first picture shows the joint after the third drop, and the second shows the joint after failure. In the first photograph, the rail has parted, the weld has cracked slightly along the seam, and the joint plate has been fractured. This specimen was made by the Capital Traction Company. As has been said it is a seam weld, and is made by the carbon arc process under normal conditions and with the standard practice of the company. Figure two shows this joint, with eleven similar ones, after they have been completed on 7th Street, through the Mall, about 900 feet south of B Street Northwest, in Washington, D. C.

The rail section used was an A. E. R. E. A. Standard 7 inch Trilby B. S. Co., section Number 122-407A. Standard Number 1 plates, rolled by the

Fig. 2—Construction of Test Joints

Lorain Steel Co. were used. The welding rods were 9-32 in. by 24 in., grade Number 10. The welding flux consisted of the commercial soda ash commonly used in such work. A 5-16 in. by 12 in. carbon electrode and a Lincoln, Type W, Welding Machine were used. The amperage for all seams ranged between 275 and 300, while the potential drop across the arc was 46 volts.

A sample filler rod taken from the bundle used in making this weld showed the following analysis:

Silicon, .02 per cent; Manganese, 1.04 per cent;

(Continued on Page 48)

Engineering Experiment Station

Milo S. Ketchum

Dean, College of Engineering and Director, Engineering Experiment Station

The field of science may be divided into pure science and applied science. The distinction between pure and applied science is one not of method but of aim. The methods employed by the chemist and the physicist are to a very great extent the same as those used by the engineer. While the worker in pure science is not necessarily interested in the utilization of his discoveries, it is a striking feature of the history of science that nearly every discovery in pure science has found a practical application. It is the province of the engineer to select those laws known to science and to apply them to the solution of industrial problems. To make the application of known scientific facts and discoveries may require additional experiments on a much larger scale than was used in the original investigations. In engineering research, it may also be necesary to carry on investigations in pure science in fields not studied by the pure scientist. Engineering research requires that investigations shall be undertaken on a larger scale and makes it necessary to have special equipment and trained investigators.

Dean M. S. Ketchum

The Engineering Experiment Station of the University of Illinois, the first of its kind in existence, was established by the Board of Trustees on December 8, 1903. The management of the Station is vested in the Executive Staff, composed of the Director and his Assistant, the heads of the several departments in the College of Engineering, and the Professor of Industrial Chemistry. All members of the teaching staff of the College are encouraged to engage in scientific research either directly or in co-operation with the research corps, which is composed of full-time research professors, research assistants, research graduate assistants, and special investigators.

The results of the investigations are made available by bulletins published by the Engineering Experiment Station. Circulars are occasionally published which give important information that is not readily available to the clientele of the Engineering Experiment Station. The publications thus far issued consist of 136 bulletins and 10 circulars, with three bulletins in press. All publications are distributed free to those persons on the regular mailing list of the Station, and to others on request. After the number of copies of each bulletin is reduced to a definite limit, a charge is made for the remainder of the copies.

The engineering departments are conducting research work in various fields with funds regularly available for the work of the Station. Many of the investigations have been thus undertaken because of the need of reliable information in particular fields, resulting from professional experience or study. Such work is very stimulating both to the teacher and to the student, and in addition, has produced many valuable results.

In addition to the investigations in scientific research, the Engineering Experiment Station has been very effective in training men in the methods of engineering research. Besides the members of the research staff who are employed on a full-time basis, the Board of Trustees has authorized the appointment of fourteen research graduate assistants. These assistants are expected to devote one-half their time to research work in the Engineering Experiment Station, and one-half their time to graduate study. These assistantships are open to graduates of approved American and foreign universities and technical schools who are prepared to take graduate study in engineering, physics, or in applied chemistry. Each assistantship carries a stipend of $600 for ten months, and freedom from tuition, incidental and laboratory fees. Appointments to these positions are made for two consecutive college years, at the end of which time, if all the requirements have been met, the degree of Master of Science is conferred. The men who have been appointed to research graduate assistantships in the Engineering Experiment Station have made very excellent records. Of the 87 men appointed to these positions, 57 have received advanced degrees from the University of Illinois. Twelve of the men who received advanced degrees were retained on the College or Station staff, and thirteen are now employed by other educational institutions or scientific laboratories. These research graduate assistants have been very helpful in carrying on scientific investigations, and have been responsible for, or have materially assisted in the preparation of 24 bul-

letins. In addition to the research graduate assistantships maintained by the Board of Trustees, two research graduate assistantships in gas engineering are maintained by the Illinois Gas Association. These assistantships have the same conditions as the regular assistantships.

While the funds made available by the Trustees have been sufficient to carry on many lines of investigation, there are many investigations of large and important problems, the solution of which involves expenditures that are too large for the University to provide. Investigations of these problems can best be carried on by co-operation of the Engineering Experiment Station and individuals, companies and associations. The Engineering Experiment Station with its trained investigators, assisted by men on the teaching staff of the different departments, finds it possible to carry on investigations that could not be carried on in a commercial laboratory. In addition to the scientific quality of the work and the high position attained by previous investigations, the fact that the work was done in the Station makes the results of much greater value than those obtained under commercial conditions.

"No single agency has done more than the Engineering Experiment Station to establish the reputation of the College of Engineering." Such is the tribute of Dean Ketchum, who, in this article, tells of the work of the Engineering Experiment Station, and relates a bit of history that is of vital interest to every student and alumnus of the College of Engineering.

The following co-operative investigations are now in progress or have recently been completed in the Engineering Experiment Station:

Investigations of coal mining in Illinois are carried on in co-operation with the U. S. Bureau of Mines and the Illinois State Geological Survey. These investigations include studies of the mining, preparation and utilization of Illinois coal. The results of completed investigations are presented in a series of 41 bulletins, 15 of which are published by the Engineering Experiment Station, 17 by the Illinois State Geological Survey and 9 by the U. S. Bureau of Mines.

Investigations of the Manufacture of Gas from Illinois Coal have been carried on in co-operation with the Illinois Gas Association. These investigations have included the studies of the utilization of Illinois coal as generator fuel, of the purification of gas, and the prevention of the formation of tar emulsions.

An investigation of the Coking of Coal has been carried on in co-operation with Mr. A. T. Hert of Louisville, Kentucky. In this investigation, studies of coals have been made with special reference to their coking properties.

An investigation of the Stresses in Railway Track is carried on in co-operation with committees of the American Society of Civil Engineers and the American Railway Engineering Association. This investigation was undertaken to determine the stresses in rails and ties, and the distribution of pressures through the ballast and road bed. Three reports of progress have already been made to the co-operating societies.

Investigations of the Stresses in Chilled Cast Iron Car Wheels have been carried on in co-operation with the Association of Manufacturers of Chilled Iron Car Wheels. This investigation includes tests to determine the stresses resulting from the forcing of the wheel on the axle, those due to the direct load of the car, and those due to temperature variations resulting from prolonged application of the brakes, etc. The results of this investigation have been published in bulletins, Numbers 129, 134 and 135. An investigation of the Effect of the Size of Coal on Locomotive Performance has been carried on in co-operation with the International Railway Fuel Association. The results of this investigation are given in Bulletin No. 101.

An investigation of Warm-Air Furnaces and Furnace Heating has been carried on in co-operation with the National Warm-Air Heating and Ventilating Association. This investigation includes tests to determine the efficiency and methods of rating warm-air furnaces, and the solution of problems in connection with their successful installation and operation. Numerous reports have been made to the co-operating societies, and in addition, valuable results of the investigation have been published in Bulletins, Numbers 112, 117, and 120.

An investigation of the Fatigue Phenomena of Metals was first carried on in co-operation with the Engineering Foundation and the National Research Council. The object of this investigation was to establish the conditions affecting the failure of metals subjected to repeated stresses. The original program for this investigation has been extended to include the study of certain special problems, and is now being carried on in co-operation with the

(Continued on Page 48)

Slime-Filling Method of Combating Mine Fires

Charles H. Dodge, min.e., '24

Mine fires and other mine disasters in which many men may have their lives snuffed out in a moment, or may suffer the agony of slow asphyxiation, have always commanded the attention and sympathy of the public. On the other hand, little is heard of the men who are daily risking their lives hundreds of feet below the earth's surface in an incessant fight with nature, trying to stem the relentless advance of burning ore and timber, for it is all a part of their day's work.

At Butte, Montana, there is a mountain of copper and silver ore known as Anaconda hill and termed "the richest hill in the world," which has been burning for thirty-seven years. It is dotted with numerous shafts which pierce it to depths varying from two thousand to forty-five hundred feet, vertically. From these shafts, annually, are hoisted millions of tons of high grade copper and silver ore which constitute a very large percentage of the world's output of these metals.

During an industrial feud between the Boston and Montana Mining Company, then the world's largest producer of the red metal, and the Heinze Interests which were then active competitors in the Butte district, fire was discovered in the five hundred level of the Leonard mine, which was a famous producer of the former company. The fire had gained too much headway to be extinguished and the operators were compelled to seal off the burning section. This marked the beginning of a fight with fire which was carried on with little or no success for thirty years.

The Butte district, of which Anaconda hill is a part, comprises an enormous batholith of monzonite which is faulted and irregularly fissured to great depths. Because of the faulting, and also on account of the removal of great quantities of ore, there is the continual danger of ground movements. These disturbances often throw the shafts out of line, cave the mine workings and in other ways handicap and endanger the workings underground. The fissures, especially those in Anaconda Hill, enclose large veins of chalcocite, Cu_2S, the most valuable copper ore. Chalcocite contains a large percentage of sulfur upon which the fire is feeding.

Until 1918, no efficient method had been devised with which to control the ever encroaching fire. Wherever the fire had been encountered attempts had been made to extinguish it with water-flooding, but these attempts were usually failures. However, in 1916-17, a plan was developed by which it was hoped to secure better results. C. L. Burrien, superintendent of mines for the Anaconda Copper Mining Company at Butte, C. E. Nighman, of the geology department of the company, and H. J. Rahilly, fire foreman at the Rains Mine which is owned by the same company, combined their experiences in mine fire fighting, and the slime-filling method was the culmination.

The slime-filling method consists of forcing mill tailings, a mixture of sand and crushed rock, passing an eighty mesh screen, into the burning area. This mixture drowns the fire fills the cavities left behind, and thus prevents further outbreaks in that particular section.

To put the plan into operation it was necessary to secure an almost inexhaustible supply of fine sand or crushed rock near at hand to avoid excessive transportation costs. Fortunately the tailings from a nearby mill, the Black Rock Flotation Mill, met this demand. A wooden flume, one-half mile in length, was constructed from the foot of the Black Rock tailing pond to the Rains Mine, where production had been halted, and which was to be used solely for access to the burning ore. A view of the flume is shown in the accompanying illustration.

Pumps were installed at the head of the flume, and near the shaft mouth of the Rains Mine, large boxes were erected in which the sand and water were to be thoroughly mixed. Six-inch pipe mains were hung in the shaft and then laid in the intermediate levels above the fire zone, to carry the slime to the heads of the tunnels. The tunnels—drifts or cross-cuts as they are termed in mining language—are driven under hazardous conditions and as they near the burning ore, the work of driving them becomes more and more dangerous and exhausting. The utmost precautions are taken to protect the men and the mine workings. Several hundred feet back from the head of the tunnel, which is separated from the actual fire by only a thin shell of rock and ore, fire-doors are erected. These steel doors can be cement-sealed, so as to be air-tight and fire-proof, in less than three minutes.

The miners wear oxygen-supplying helmets and heavy clothing when breaking through the rock shell at the head of the tunnel. The heavy, poisonous sulphur gases and the terrific heat compel such safety measures and even with this equipment, the miners must be withdrawn after fifteen to twenty

minutes of work. The walls are so hot that a worker would be burned if he touched them.

When the head of the tunnel is broken through the slime pipes are brought up as close as possible and the slime is pumped into the burning workings. If an old stope has been entered it may require a long period of time with a corresponding large quantity of slime to fill the cavity up to the level of the pipes. If a stope is entered near its "sill" the tunnel is concrete bulkheaded with the pipes projecting through. Such bulkheads are of heavy construction in order to withstand the enormous back pressure of the slime.

When using the drill holes to convey the slime to the fire, the tunnel is allowed to approach to within fifty or sixty feet of the fire surface. The excavating equipment is then withdrawn and the diamond drills are set up. The holes, which are three to five inches in diameter, are drilled at a downward angle as most of the tunnels are driven above the fire zone. The drilling progresses at an average rate of eight to ten feet per eight hour shift, with the drill teams working in relays of three shifts every twenty-four hours. Almost every formation, from the seemingly impenetrable "copper glance" to the soft talc, is pierced. The latter is very troublesome because of its squeezing property which causes it to tighten on the drill and contest every inch of advance.

On holing through, live steam and gases follow the drill rods as they are withdrawn, giving a fair idea of the seething caldron that is trying to escape. The slime pipes are immediately adjusted to the mouths of the drill holes and the slime, under a pressure of hundreds of feet, is forced into the burning section. Explosions have occured due to the generation of steam as the water encounters the intense heat but such occurences have been rare. Nevertheless, the danger is always present. Immense quantities of slime are required as may be illustrated in the Rains Mine where over one million tons of slime have been pumped into the burning section.

In order to raise the underground water which has a natural drainage of thirteen hundred gallons per minute, as well as the water that seeps in from the slime filled areas, the largest underground pumping stations in the world have been installed in several of the mines bordering the fire zone. The pumping stations are erected in the twelve, twenty-two, twenty-eight, thirty-four and forty hundred foot levels. Slightly smaller stations are placed in

One-half Mile Long Wooden Flume

the twelve and twenty-eight hundred foot levels of the Leonard Mine. The latter mine has received many visits from famous engineers and leaders in the industrial world, and attracted favorable comment from the late President Harding when he visited the Leonard mine during his western tour last summer.

The pumps, which are built in the shops of the A. C. M. Company, are the products of their own engineers, and are designed to elevate the water at the rate of six hundred gallons per minute. In the early stages of this work much difficulty was encountered in the rapid wearing away of the plungers. The cutting power of the water, which still carried a considerable quantity of rock particles in solution, was enormous and necessitated rapid replacement of the steel plungers and lining. A compound of steel and silica was tried with fair success but not until these had been replaced by porcelain plungers was any sort of permanency enjoyed.

It might be added here that the slime water and natural underground water carries with it an appreciable amount of copper. After being elevated to the surface it is run through leaching troughs and tanks where most of the copper is recovered thereby effecting a substantial financial return on the original outlay and upkeep. The main pipe lines through which the water is raised to the surface are lead or wood lined to prevent wear and erosion and to better protect the joints. The pipe-elbows, intake bowls, and plunger bowls are made of phosphor-bronze and have been in continuous service for many years.

The slime method of drowning the fire and filling the cavities with sand and crushed rock is proving successful, although the fire continues to eat its way into new sections, thereby endangering the workings of other mines. Much of the fire zone has been reduced but it would be impossible to predict the time when the fire hazard in Anaconda Hill will have been made negligible.

A number of the mines, which are adjacent to the fire, experience extreme difficulties because of heat, due not only to increase of temperature with depth but because of returning air from about the fire areas. The operators are often compelled to seal off important workings as the fire approaches. Stopes and drifts, which are almost too hot to work, are termed "hot boxes" by the miners and they are all that the name implies.

Because of the inaccessibility of some of the abandoned "gobs" and worked out stopes which are burning, much valuable time is consumed in approaching the fire thus allowing it to gain great headway. Many mines have their own distinct odor and a change in odor, indicating the presence of gases foreign to the natural ventillation, can be noted by those who have been associated with the mine for a considerable time. After the presence of

Driving a Drift

strange odors is detected an investigation is made, and often a new location of the fire is discovered. This natural aid has helped in limiting fires to comparatively small areas which otherwise might have developed without notice, to very serious proportions. Because of the interventilation of many of the mines there is the added danger of the escape of gases from one mine to another. However, this danger is steadily being reduced as the mines are being made independent of each other in this respect.

The sealed off parts are to be later reopened and the burned ledges and unfinished stopes mined for their copper and silver. Even the localities where the fire has had full sway will be reopened by tunnelling into the "smelted ore," and with regular stoping methods much of the copper will be recovered.

The Anaconda Copper Mining Company has accepted a big scale problem but with the service and willing co-operation of its employees, the courageous and persistent mine fire-fighters, success, even though not complete, is being attained. Millions of tons of the red metal are being spared for commercial and domestic use and we, who benefit by these efforts, must place the honors where they are due.

The higher men climb the longer their working day.—Cardinal Gibbons

The Carpenter Bridge

H. E. Wessman, c.e., '24

The Carpenter Bridge, a 5-span reinforced concrete deck girder bridge, is located on the Rock River in Winnebago County about 14 miles north of Rockford, Ill. Each span is 65 feet long—the maximum girder span permitted by the State of Illinois Specifications. There are three girders in each span, one on the center-line of the bridge, and the others 8 feet 3 inches to each side of the center-line. Each girder is 21 inches wide, 4 feet 1 inch deep, and 68 feet long. The floor slab, whose thickness tapers from 7 1-2 inches at the center to 6 inches at the edges, carries a 1 inch concrete wearing course. The hand rails are of brick laid in Flemish bond.

The site selected for the new bridge is 45 feet upstream from, and parallel to, an old bridge spanning the Rock River. Naturally the old bridge greatly facilitated construction of the new structure. The north bank of the river, being somewhat higher than the south bank, offered the most advantageous location for the mixing plant. A two-bag mixer was placed low enough on the bank to permit the aggregate and cement to be chuted into the drum. The aggregate stock pile, consisting of bank run gravel containing 60 percent sand, was located higher on the bank, and a bucket elevator lifted it into a hopper, which discharged into a batch box above the mixer. The cement shed was built around, and on the same level as the batch box. The mixed concrete was discharged into a skip at the bottom of a hoist and raised to an industrial track where it was poured into cars and transported to the necessary location on the structure.

Four bents, of five piles each, were driven in the north bank, north of the abutment. Figure 1 shows some of these piles partly supporting the mixing plant. An industrial track was then laid along the center of the bridge location and a stiff-leg derrick and hoisting engine were set up and moved along it. The method used in shifting the derrick and its auxiliaries was rather unique. The stiff-leg boxes were mounted on trucks running on tracks parallel to the center track, and the derrick, with the hoisting engine behind it, was also mounted on trucks which moved along on the center track. Such an arrangement made it easy to shift the derrick about. Everything was blocked in place until all the piles within the reach of the boom were driven. The piles in each bent were then tied together across the top with 10 inch by 10 inch timbers held in place by pins. Stringers, built up of 3 inch by 12 inch planks bolted together, with 3 inch separators between each plank, were then laid over the 10 inch by 10 inch timbers and the track was laid on top. The blocks were then removed from beneath the derrick and its auxiliaries; a pusher timber was placed between the derrick base and the engine, and all the equipment was pushed ahead over the tracks which had been laid. After the north abutment was poured, 5 bents of piling about 14 feet apart were driven in the first span. The derrick was moved up and the first pier was poured. Similar procedure was followed in the remaining spans, until all the four piers and the south abutment were completed.

The falsework piles varied from 25 feet to 30 feet long and were driven into the river bottom about 5 feet or 6 feet. The tops then cleared the final bridge floor level about 2 1-2 feet and gave the derrick the necessary working height. The three inner piles of each bent were driven on the center-lines of the three girders, so that after the tops were cut off, they would support the direct load of the girders, during the pouring and setting of the concrete. Figure 2 shows the location of the piles and also the ends of the girders in the second span. As you will note in the figure, the three inner piles have already been cut off below the level of the girders.

The procedure for each abutment and pier was practically identical. A cofferdam 15 feet by 32 feet was built, as shown in Figure 6. The waling, the heavy framework seen inside the cofferdam, was first set up and floated to its place in the river channel, where it was suported by a pile at each end. The tongue and groove sheet piling consisting of 4 inch by 10 inch timbers was then driven around the waling. Before the piling could be driven to the required depth, it was necessary to excavate inside the cofferdam. A clam-shell bucket was used which deposited the excavated material—mostly sand and gravel—around the outside of the sheeting, until a small island had been formed around the hole. The pressure from this fill on the outside was then sufficient to hold the waling in place without any additional support. The sheet piling was ultimately driven to about 3 feet below the level of the bottom of the footing, while the excavation was carried only about 1-2 foot below this level.

The nature of the subsoil at the Carpenter Bridge site necessitated piles under all the footings.

Future Metallurgy of Zinc and Copper Sulphides

A. E. Drucker
Professor of Mining Engineering

The hydro-metallurgical treatment of table and flotation concentrate on the spot, in a good many cases has proven to be more profitable than transporting it to a smelter. The smelter generally gains at the shipper's expense mainly through the extraction of the metal and the moisture deduction. A large number of mining companies that, in the beginning, shipped gold and silver-bearing concentrate to a smelter, paying in some cases exhorbitant freight rates and smelter charges, finally adopted a hydro-metallurgical process at the mines with the result that large additional profits were realized. The saving on drying, bagging, carting, and transporting ranged from $5 to $20 per ton plus 3 to 7 percent increase in the recovery of the gold. A saving was also made in certain cases on the cost of treatment. The following list includes some important companies that have made this change:

	Tons Treated	Metal Cont'd
Oriental Consolidated, Korea	2400	Gold
Alaska Treadwell, Alaska	3000	Gold
North Star, California	3000	Gold
Esperenza, Mexico	3000	Gold
Waihi, New Zealand	500	Sil.-Gold
Frontino and Bolivia, Columbia	150	Gold
Goldfield Consolidated, Nevada (Preliminary roast)	2400	Gold-Sil.
Ivanhoe, Australia (Preliminary roast)	1950	Gold
Golden Horseshoe, Australia (Preliminary roast)	2000	Gold
Oroyo-Brownhill, Australia (Preliminary roast)	1000	Gold
Lake View Consuls, Autsralia, (Preliminary roast)	1800	Gold

The cost of treatment per ton at the above plants varies from $2 to $6, while the recovery of the precious metals is from 90 to 97 percent. The successful treatment on the spot has been developed during the past ten to twelve years. There is equally as great a field with similar acid-leaching treatment in the case of zinc and copper sulphides, and I believe that hydro-metallurgy will become eventually as important to the zinc and copper industry as cyanidation to the gold and silver miners. Present-day smelting methods of extracting zinc and copper from table and flotation concentrate will be gradually replaced, except in a few special cases, by combined roasting and leaching, producing electrolytic zinc and copper direct in marketable form.

In the consideration of the acid-leaching process the first factor is the character of the concentrate. The table and flotation concentrates obtained from the porphyry copper ores at Bingham, Globe, Ely and Miama should be amenable to acid-leaching after a preliminary roast. This concentrate contains 10 to 28 percent of copper, 16 to 23 percent iron, 22 to 32 percent sulphur, and 18 to 28 percent insoluble, and with the exception of the Bingham concentrate there is no appreciable amount of gold and silver.

The following is a general outline of the treatment I suggest for the porphyry copper sulphides or similar material amenable to acid-leaching. No attempt has been made to go into the details of roasting, leaching, and electro-precipitation. As a general rule porphyry concentrates contain practically no zinc, lead, silver or gold, and therefore, are particularly suited to roasting and acid-leaching. Copper is one of the most readily soluble of all metals, and one of the most easily precipitated electrolytically. Small amounts of zinc present would not not effect the operation materially. The zinc problem has been satisfactorily solved at Anaconda. Where gold is present to the extent of $2 to $3 per ton of concentrate, as in certain cases at Bingham, Utah, acid-leaching would not recover this, and it is questionable if smelting could be replaced advantageously.

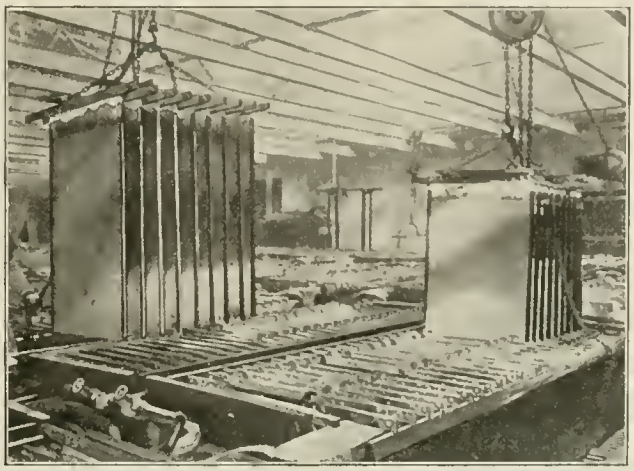
A multiple-hearth muffle roasting-furnace has been successfully employed at low temperatures for sulphate-roasting, and in some cases as high as 80 percent of the copper was rendered soluble in water as sulphate. The total soluble copper has been increased to over 95 percent by the use of a weak acid-solution. If the sulphides are roasted so as to make about 50 percent of the copper soluble in water, the remaining copper may be extracted with the regenerated acid resulting from the electro-decomposition of this metal. For every pound of copper deposited 1.54 pounds of acid are generated. With such regenerative methods no additional acid need be provided and no serious fouling of solutions is likely to occur. The Chile Copper Co. offers one example. The sulphurous gases from a roasting furnace have been applied direct to the wetted crude ore as a means of dispensing with the usual expensive acid-making plant. The sulphatizing of the wetted roasted sulphides with sulphur gases, followed by leaching with the regular solutions from the plant, is one cheap and effective way of getting the copper into solution. The elimination of sulphur from the sulphides is accompanied by the evolution of con-

siderable heat generated during its oxidation. Concentrate containing as low as 15 percent sulphur has been roasted to a certain point in multiple-hearth furnaces without the addition of fuel preliminary to smelting. On concentrate high in sulphur, that is, from 20 to 35 percent the roasted material may be reduced as low as 7 to 9 percent sulphur without the use of fuel. Reducing this 7 percent down to 3 or 2 percent requires extra fuel.

For a sulphatizing roast, the temperature should not exceed 600 to 650 degrees centigrade. Copper sulphides are not particularly sensitive to high temperatures, and if sintering or fusion occurs, it is impossible to get a satisfactory extraction. The product, when well roasted for acid-treatment, will contain from 2 to 3 percent of sulphur containing practically all of the copper in the form of oxide, some sulphate, and the iron mostly in the insoluble ferric state. The Wedge multiple-hearth type of furnace is being successfully used for the chloridizing-roast of silver and copper ores. The furnace may be fired by oil, gas, coal or wood, if a more thorough roast is desired for hydro-metallurgical work. In the case of fuel oil, it can be injected into the lower finishing-hearths as desired. If solid fuel is used the enclosed fire-box type may be employed. The fuel consumption with wood or coal usually varies between 9 and 16 percent of the weight of the concentrate, when roasting to less than one per cent sulphur remaining in the form of sulphide. In roasting sulphides down as low as 7 to 10 percent, fuel is not ordinarily necessary. At Kalgoorlie, Western Australia, the following results were obtained on concentrate:

Company—	Lake View	Oroya-Brownhill	Ivanhoe
Percent sulphur in Raw Product	25-30	35	27
"Sulphide" sulphur percent in roasted product	0.35	0.20	0.11
Wood used percent by weight	9.8	16.0	14.0
Furnace used	Edwards	Murton	Edwards

I believe, that with the modern Wedge or McDougall furnace, concentrate of copper sulphide could be de-sulphurized to one-percent "sulphide" sulphur with a consumption of 6 to 8 percent by weight of wood or coal. At the Goldfield Consolidated, Nevada, nine gallons of crude oil is required per ton of concentrate or 3.3 percent of the weight. The raw concentrate contains about 19 percent sulphur, and the roasted product 0.15 percent sulphur. The cost of roasting sulphides varies from 55 cents to $1 per ton, depending upon the tonnage, the degree of roasting, the type of furnace, the fuel used and other local conditions. At Butte, Montana, and at Garfield, costs have been as low as 35 cents per ton for incomplete roasting in McDougall furnaces, reducing the sulphur down to 7 percent prior to melting. I see no reason why the cost of this preliminary operation to acid-leaching with a well designed roasting-plant to treat 200 tons of sulphides per twenty-four hours would not average about 60 cents per ton treated. The cost of a modern roasting-plant of the Edwards, Ridge, or Wedge and McDougall multiple-hearth type, will vary between $800 and $1,000 per ton daily capacity for de-sulphurizing.



Electrolytic Deposition of Copper

After roasting the sulphides, the copper should be in the form of sulphate and oxide, although some sulphide will remain, as a complete roast in this particular case is not desired. The roasted material is then treated by the ordinary sulphuric-acid-leaching process. The oxide of copper is readily soluble in weak-acid solution, and to a certain extent by the ferric sulphate formed by air-agitation of the pulp, and by the electro-deposition of the impure copper solutions. Copper sulphate is practically all soluble in water, especially when some acid is present. After a proper roast it is an easy matter to get the copper into solution very completely; but, as all metallurgists, know, the most difficult part of the process to precipitate the metal efficiently and economically into a marketable form. Most of the improvements in the future will be in the electrolytic deposition of copper from these complex solutions. Considerable advancement had been made with this at Anaconda, New Cornelia and at Chuquicamata, Chile. If there is lime in the original ore, it will not be present in the concentrate in injurious amounts. The same is largely true with other impurities which usually cause a loss of acid and also contaminate and foul the electrolyte, causing trouble in the electrolysis and producing impure copper. I realize that it is not all smooth sailing

A number of 12 1-2 ton piles, about 20 feet long, were driven under all the piers, and 10, 13, and 15 ton piles were driven under the abutments.

The next step consisted in placing all the required piles within the cofferdam. Figure 7 shows a pile in process of being driven and the remainder of the piles leaning against the sheeting. Inasmuch as sand only was encountered in the bottom, it was an easy matter to drive the piles with the aid of a water jet having a pressure of 100 pounds per square inch.

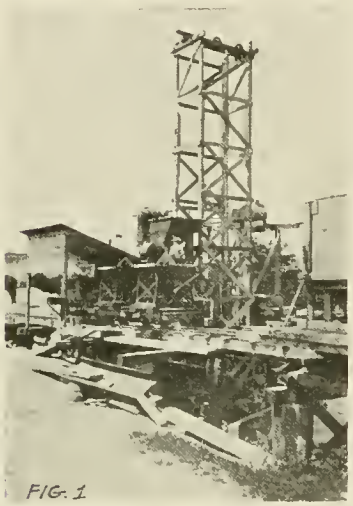


FIG. 1

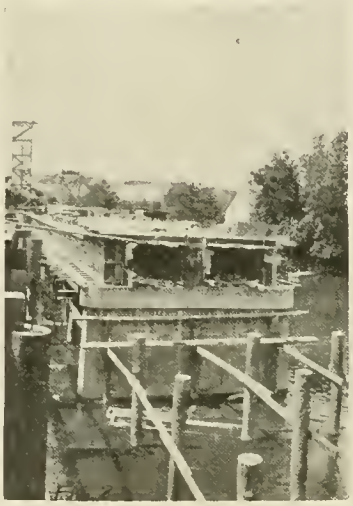


FIG. 4

FIG. 5

Referring again to Figure 7, the vertical length of pipe seen next to the leads of the pile-driver is the "jet." Technically, the jet is the stream of water issuing from the nozzle at the end of the pipe. The jet is placed a few inches from the pile and both go down simultaneously. After watching the manner in which they slip into the ground, one would think that the piles could sustain no load whatever, but after the last foot has been driven with a hammer, the penetration after a wait of five minutes would be less than one-fourth inch with a 2250-lb. hammer. Figure 9 shows the piles at the bottom of the cofferdam, after being driven. The tops were then cut off, so that the piles would have a penetration of nine inches into the bottom of the footing. It might be added that the length of the pile after cut-off is the length which determines the amount paid the contractor for piles driven.

Next, the rectangular form for the footing was built up within the cofferdam. The bottom around the piles was then excavated to about four inches below the flooring level and completely covered with a four-inch layer of large rock, with the exception of a small channel through the middle which served as a drainage way for the water seeping into the dam. The water then ran into a pit at one end of the dam, from where it was pumped outside. Several boards were placed over the afore mentioned channel and the entire bottom was then covered with a layer of tarpaper, through which the piles penetrated nine inches. The pier footing was then poured.

After the footing had hardened sufficiently, the forms for the shaft of the pier were placed. These forms were made of one-inch boards braced with 2 inch by 6 inch uprights on 2 foot centers, as shown in Figure 8. The forms for the first three piers had been wired together, but the wire had not proved entirely efficient, so in the fourth pier, the forms were tied together with one-half inch round steel rods spaced on three-foot centers. These were very satisfactory, for they made the placing of the con-

crete easier and prevented bulges from developing. Figure 8 also shows the method of pouring the piers. The derrick lifted the V-buckets of concrete from the track above and swung them out into place above the forms where they were discharged. Figure 1 shows the train of buckets being loaded at the mixing plant, prior to being sent out to the pier.

After the pier shaft was poured and had hardened, the forms were stripped off and the forms for the cap were set up. In Figure 2 may be seen three piles directly adjacent to the shaft of the pier. They are not driven into the river bottom, but are merely resting on the footing of the pier. There are also three more piles on the other side of the pier in a similar position. The form for the cap was built upon these piles and the cap was then poured—this completed the pier.

From a previous paragraph, you may have obtained the impression that all the piers and abutments were finished before any of the super-structure was poured. This was not the case however. The first span was poured before the third pier was completed and by the time the south abutment was finished, four of the spans had been poured. The procedure for each span was identical. As you will remember, the falsework piles when first driven were about 2 1-2 feet above the bridge level and the derrick moved over a framework above them. After the piers were poured the falsework piles had satistied the demands of the derrick, so the tracks, stringers and heavy timbers were removed from the 3 inner piles and they were cut off to the level shown in Figure 2, and the forms for the girders were built. In order to do this 8 inch by 8 inch timbers were laid transversely across the tops of the piles. Three rows of stringers, one under each girder, were then laid down longitudinally. Next came 2 inch by 6 inch planks, flat side down, which were laid transversely across the stringers. These can be seen in Figure 2, protruding from beneath the girders already poured. On top of these planks, the girder forms, consisting of 1 inch boards were built. Figure 2 also gives some idea of the manner in which this was done. A track as shown in Figure 10 was now placed down the center-line of the bridge about 2 feet above the floor level, and the concrete was carried out in side-dump cars, and chuted down into the girders.

Two days elapsed between the pouring of the girders and the floor slab. In this interval, the forms for the floor slab were completed and the floor

(Continued on Page 46)

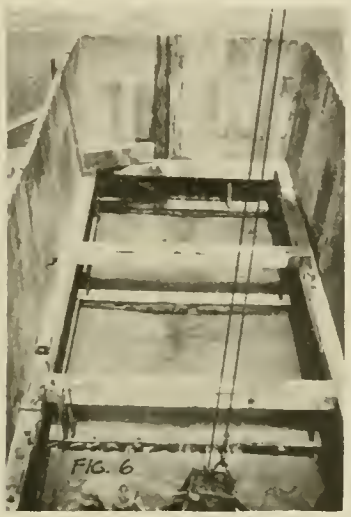


FIG. 6

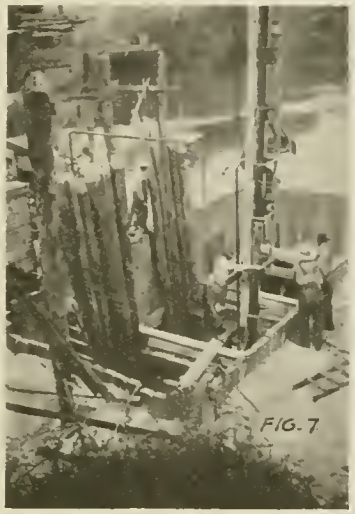


FIG. 7

FIG. 8

FIG. 9

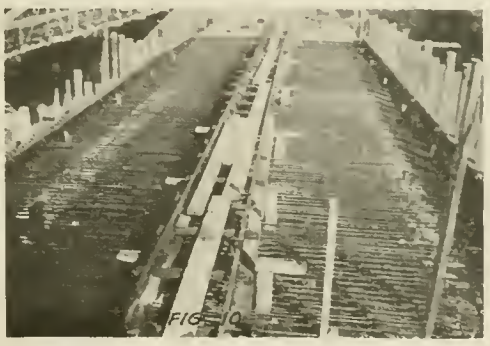


FIG. 10

with the acid-leaching process and especially with the electric precipitation, but I do say that the problems are no more complex and difficult than with the cyanide-gold leaching process, which during the past thirty years has been perfected to a high point. There are no such complex solutions to deal with as compared with those resulting from cyanide-leaching of mixed sulphide-gold ores.

At the present time the electrolytic process on the spot for the recovery of 99.95 percent copper slime will not give the best results. The presence of slime is detrimental when it goes above this amount, and the extraction will gradualy fall off as the amount of slime increases. The most efficient and profitable method for leaching roasted concentrate finer than 150 mesh would be air-agitation of the acid pulp of a consistence of one to two, or one to three, in Dorr agitators with 5 to 10 percent acid solution, and with counter-current decantation in a series of Dorr Thickeners. A water wash would

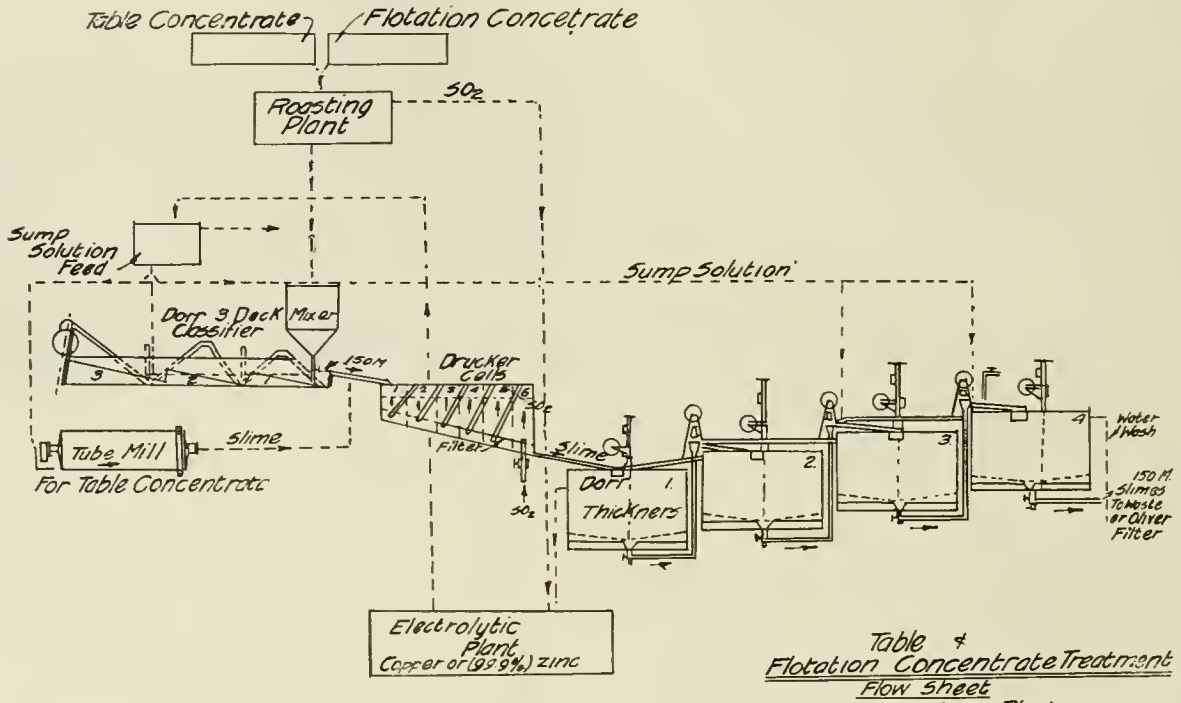


Table of Flotation Concentrate Treatment Flow Sheet Acid Leaching Plant for Copper & Zinc Sulphides

from acid solutions offers economic possibilities, especially when one considers the present cost of transporting and remelting blister copper into anodes and refining these at the Atlantic Coast refineries. The regeneration of the acid solvent to a large extent is a most important consideration. Sulphate solutions, resulting from acid-leaching in practice, will require a voltage of about 1.5 to 3, with a current density of 5 to 12 amperes per square foot. In practice it has been found that one to two pounds of copper will be deposited per kilowatt-hour, regenerating the acid.

With concentrate containing considerable slime and material finer than 200 mesh, the ordinary sand-percolation treatment in vats would not give a satisfactory extraction. It has been found on the Rand, South Africa, and in other places, that a sand-charge containing more than 2 to 3 percent be used in the last thickener. I think that there would not be any need of a vacuum or pressure-filter at the end of this operation for removing the last traces of dissolved copper. This part of the operation would be identical with the latest practice in cyanide counter-current decantation which has proved so successful on gold and silver ores. For treating the heavy material, coarses than 150 mesh, we have the Dorr agitator, followed by the multiple-desk washing classifier, which is suitable for counter-current leaching and washing. A four or five-deck machine could be used for this purpose or several Dorr Classifiers operating in series. All machinery used in leaching must be acid-proof.

Costs of construction of a plant varies largely in different parts of the United States, depending upon the cost of material, transportation, labor, and

(Continued on Page 44)

A Modern Broadcasting Station

H. E. Goldberg, e.e., '27

Station WHB is the broadcasting station of the Sweeney Automotive and Electrical School of Kansas City, Mo. It is designated as a "Class B" station, indicating that it is one of the higher powered and better equipped stations, being required to conform to strict government regulations as to the type and quality of the broadcast music and speech.

In considering WHB, it is convenient to divide the equipment into three parts:

Antenna System, Power Plant and Studio.

Antenna—The antenna is supported by two steel towers of the latticed, self-supporting type. These towers are 175 feet high, located on the top of the Sweeny Building, making the total height 305 feet. The antenna itself is of the 4 wire, "T" type, that is, the lead-in drops from a point midway between the two ends. Each wire is composed of 21 strands of No. 22 phosphor-bronze wire, twisted together to form a cable of considerable strength. The lead-in is in the form of a cage, the twelve wires forming it being equally spaced around the circumference of one-foot copper rings that are spaced at intervals of 25 feet. As the lead-in approaches the building, the wires are bunched into a cable that is taken into the building by means of a large insulating bushing.

A counterpoise is used instead of the ordinary ground connection, having the appearance of another antenna located below the regular antenna. It is used instead of a ground, due to the fact that it lowers the resistance of the antenna circuit, giving a greater power output from a given equipment.

It is made up of nine wires 100 feet long, spaced two feet apart; the lead-in is taken from one end instead of the middle as it was in the antenna. The counterpoise is suspended between the two towers at a point 150 feet below the antenna. A winch of the geared type at the base of each tower carries the steel cable which holds the antenna in place. These winches make it possible for one man to lower the antenna for repairs, if necessary.

Power Plant—The transmitter is a standard Type 1-A Radiophone Transmitter manufactured by the Western Electric Co. The set proper, which consists of three panels, is located in the operating room, shown in Fig. 1.

The radio panel, containing the apparatus for the generation and modulation of the radio wave, is shown on the right of the picture. The panel is divided into three sections, or shelves. The lower shelf contains the connection-board and a filter system which removes the pulsations in the direct current that supplies the power necessary for the operation of the vacuum-tubes in the upper shelf.

The middle shelf holds the coils, inductances, and condensers necessary for the regulation of the power and wave length of the emitted wave. It also holds a time relay which prevents the operator from applying the plate voltage to the tubes until the filaments have been lighted for at least 15 seconds, thereby greatly increasing the useful life of the filaments.

The top shelf contains the vacuum-tubes, which are the heart of any broadcasting station. The tubes are Western Electric, types 212-A and 211-A. The 212-A, of which there are four, are rated at 250

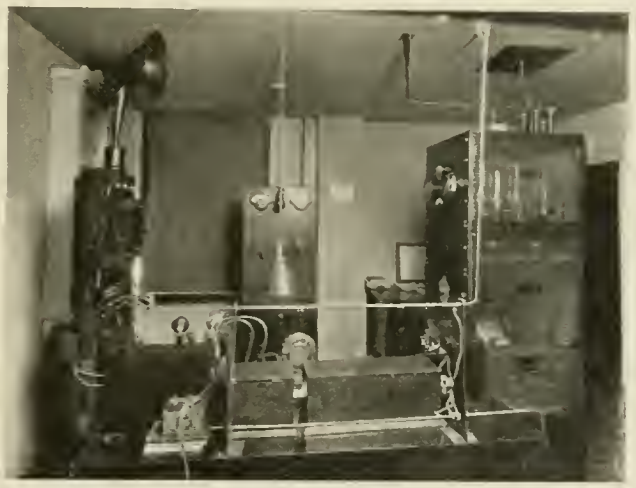


Fig. 1—Radio Operating Room

watts output. Two of these tubes, known as oscillators, generate the radio wave, at a wave length of 411 meters, and at a power of 500 watts. The other two 212-A tubes, known as modulators, modulate, or mould the radio wave at speech frequencies. The smaller tube, type 211-A, is rated at 50 watts and is used as a speech-amplifier tube, its function being the building up or amplifying of the speech or music that is received, from the speech-amplifier panel, which will be described later. On top of the panel is a condenser and an automatic change-over switch. The condenser is a Dubilier mica insulation type and is used as a series condenser in the antenna circuit to reduce the wave length, in order to lower it to 411 meters or below. The change-over switch automatically disconnects the antenna from the receiving set and connects it to the broadcast-

ing set as soon as the main power switch, starting the motor generator set, is thrown. The antenna lead-in is connected to the change-over switch, and may be seen where it goes through the ceiling, insulated by a large, square, bakelite plate. On the front of the panel are four meters for reading the antenna current, oscillator plate current, modulator plate current and the oscillator grid current. There are also two dials, one for adjusting the wave length, the other for controlling the power input to the plate circuit of the tubes.

The panel on the left is the speech-amplifier panel. This amplifier is a three stage power amplifier used to increase the current received from the microphone, which is used to pick up the speech or the music being played in the studio or at outside points. Also, there is a telephone switchboard of ten lines, connecting the station with different points throughout the city in order that interesting speeches, church services, concerts and other good entertaining matter may be broadcast without the use of the studio. In broadcasting from outside points, another speech-amplifier is used to amplify the speech, music, etc., before it is sent to the station over the telephone line. This is done in order that the volume of the noises in the telephone line will be negligible, as compared to that of the material to be broadcast, thus improving the quality of the transmission.

The panel in the back-center of the picture is the power panel. This panel contains the switches and the automatic starter, necessary for the starting of the motor-generator, and the field rheostats for filament and plate generators. A circuit-breaker is provided to protect the high-voltage generator, also voltmeters to read the voltage of both generators.

On the center of the table is seen a round metal instrument, the microphone, which is used to pick up the speech, music, etc. The microphone is one known as a double button transmitter. It has a single diaphgram; but, instead of the usual single cup containing the carbon granules necessary for its operation, it has two, one on either side of the diaphgram. This construction is to enable it to pick up from both sides equally and to increase the sensitivity.

The motor-generator is an "Eck" make and is located in a room adjoining the operating-room. It is mounted on a bed of felt padding to reduce the vibration to a minimum, as the absence of extraneous noises is very necessary in the efficient operation of a broadcasting station. The motor is a 5 H. P., 220 V., 3 phase, induction motor, run from the city power supply. The high-voltage generator, which is located next to he motor, is of the double commutator type, developing 800 V. at each commutator, or 1,600 V. altogether. This furnishes the direct current for the plates of the tubes. The low-voltage generator, in the background, develops 16 V. D. C. and is used to light the filaments of the tubes. The motor and the two generators are joined together by flexible couplings attached to their respective shafts.

Studio—The studio, the room from which most of the broadcasting is done, is located on the tenth floor of the building and adjoins the operating room; it is rather unique in construction. It has a

Fig. 2 - Broadcasting Studio

room 20 feet by 25 feet, with a 14 foot ceiling, as is shown in Fig. 2. The walls are lined with three layers of cotton-flannel cloth, with a quarter inch air space between each layer, and then covered with red velvet. This is done to prevent echoes from being present, which would greatly lower the quality of the broadcasting. The ceiling is treated in the same manner, except that it is covered with grey velvet. The cornices, columns, frames and door and window casings are finished in Caan Stone effect. Receptacles are provided in the baseboard so that the microphone may be plugged in at different positions in the room for various classes of announcements, solos, or orchestrations. A reception room, furnished like a Japanese garden, is provided for the convenience of the artists appearing on the program.

Summarizing, the operation of the station is as follows: the microphone, situated in the studio or broadcasting point, picks up the sound waves and converts them into electrical energy, which is sent through the speech-amplifier and intensified, thence to the radio panel where it is converted to radio waves, modulated at speech frequencies, and then sent up to the antenna, where it is radiated into the ether in all directions.

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The International Air Races

Bertram Pond, m.e., '25

A large number of aeroplanes were on hand for the International Air Races at Bridgeton, Missouri, on October first. The air was foggy and it had been raining so that aerial demonstrations were out of order. Though the field was a sea of mud on the surface, the preparations had been so thorough that the soft top layer of loam had been removed; making it possible for ships to land and taxi to the many lines on the hard clay under the thin mud. The field was in excellent condition for the St. Louis events. These events were postponed only three days thanks to the removal of the surface soil.

The first day of the races at the St. Louis Field, as the place was named, marked the last day of the "On to St. Louis Race." This was a race of the ships coming from distant places. The winner, Casey Jones of Garden City, Long Island, in a Curtiss Oriole, was so judged on milage, small horse power and passengers. The second man came from North Dakota, alone. The third man, Meyer, from Chicago, came non-stop with a total of five people in a small 90 H. P. Heath "Favorite."

Among the several hundred ships which lined two sides of the field for a mile's distance, in rows of five and six deep were many record planes. The 78 foot wing-span Fokker Monoplane, of trans-continental fame, and its twin ship were subjects of interest to the thousands who visited the field. The racers which were in last year's Pulitzer Race were in their hangars with new paint and minor changes intended to increase their speed. The ship which made the attempt at the trans-continental trip in a more dashing fashion—"daylight to dark"—was among the silvered-wing ships in the line. Three large navy torpedo planes capable of dropping a torpedo and then speeding away at 130 miles per hour, showed that the navy is up-to-date. The ship in which Major Schroeder of Chicago and Lieut. McReady made their famous altitude flights was still a capable performer. Another old altitude machine, the Curtiss Wasp triplane, was entered in the races despite some protest as to its specifications.

Another notable ship came rolling into the field throwing mud in every direction. A door in the side of the body opened and four people in clean, full dress clothes stepped out. Two of the party were women. One of them asked the press photographer, who was begging for data for the pictures which he had snapped, "Why all of this publicity? We never received this much when we flew to New York and back!" The fifth person, the pilot, said that they had just come from Chicago in 2 hours and 55 minutes. This plane was a Breguet all metal plane which had flown to St. Louis earlier in the summer with four members of the Illinois Model Aero Club who made their entry in the Mulvihill Model Trophy Race at that time. Mr. Charles Dickinson, the owner of the ship, is the oldest pilot in the United States. He is 65 years old.

The navy easily won the Pulitzer Race and established a new world's speed record for the distance. The speed was about equal to the record speed over the faster one kilometer and three kilometer courses. The dashing colors of the ships were in keeping with the projectile-like speeds which the electric timers indicated. A most peculiar phenomenon was very pronounced in the sound of the aeroplanes as they passed overhead. The sound seemed to come from a great distance behind where the ships actually were. The great power on such small ships enabled them to climb almost vertically for a thousand feet or more.

The bright red of the 700 horsepower Wright Navy racers gave them a beautiful appearance as they hurtled along and turned the pylon in front of the timers' stand. The "Blue-Streaks" is what the local pilots named the Curtiss Navy Racers which won the race. All of the racers which showed any speed at all were equipped with corrugated sheet brass radiators which fitted around the wing contour without adding any of the usual parasite resistance which common types of radiators have. The Verville Sperry monoplanes have a chassis which the pilot could reel up into the body to cut down resistance. Woe be unto the pilot if he should attempt to land without lowering his wheels. Most of the speed 'planes were equipped with hard aluminum propellers. The "Blue-Streaks" had no shock absorbers on their flimsy looking chassis since the wheels themselves had been designed to take the shocks. The Navy was taking no chances on parts of the engines being tampered with—on the cowls of one ship, there were ten Yale locks installed.

One of the most interesting features of the races was the Mulvihill Model Race. Thirty-four entries were made in this race and all were present when the race started. These models surprised the people of St. Louis who had turned out along with the

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THE MONUMENT OF LEONARDO BRUNI

The Monument of Leonardo Bruni

Ernest Pickering, '20

The drawing reproduced on the opposite page is the work of Mr. Ernest Pickering, '20, who won the Plym Scholarship in the spring of 1921. The work presented is one of Mr. Pickering's envois, which are considered among the finest ever produced by holders of the Plym Scholarship. Below Mr. Pickering gives a short description, and a brief account of the history of the monument.—Editor.

The monument pictured on the preceeding page is one of the most pleasing and interesting examples of Italian Renaissance architecture that awaits the traveler looking for beautiful details of that period. It is to be found on the right aisle of the church of Santa Croce, in Florence. It was executed by Bern Rossellino in memory of the Italian statesman, Leonardo Bruni, who died in 1444.

This monument is composed chiefly of white marble, now mellow with age, with some variation introduced by the use of color. The lower member of the base is dark green marble; the three panels behind the figure are red porphry; the capitols, frieze, and arch bear traces of gilt; and the shield at the top furnishes a climax with its red and gold.

The width of the monument at the base is approximately ten feet and it is nearly twenty-four feet high. It is placed against the wall of the aisle and stands as a masterpiece of Italian art amid the many other monuments and tombs, with which this old 13th century church is filled. Being an early example of that beautiful style, it influenced designers of that period and of more recent times with its proportions and delicate carving. Across the nave of this church is another monument of this period almost the same in arrangement and detail. Throughout Italy one can find motive so nearly like the one pictured that it is easy to guess the source.

The work of measuring this work of architecture was simple. Armed with a "permisso" to study and sketch in the musenms, etc., which is to be secured in Rome from the Minister of Fine Arts, one has access to the works of art in Italy. Artists and architects are plentiful in that country, but the curiosity of Italian people never wanes. Where you see a crowd, there you can usually find someone sketching or measuring.

The Plym Scholarship

The generosity of Francis J. Plym, graduate in Architecture from the University of Illinois in the class of 1897, has made possible the annual opportunity for a graduate of the Department of Architecture to continue his studies abroad. The value of the fellowship is one thousand dollars which must be used for one year of travel in Europe for study of architecture. The award is made upon a competitive basis; the only requirements for eligibility are that the candidate be a graduate of the Department of Architecture of the University of Illinois and under thirty years of age.

The competition consists of a preliminary and final exercise in architectural design. The preliminary design is open to all who are eligible and have filed the required application; it consists of a problem to be executed in a period of five days. The Fellowship Committee selects the four best designs submitted in this preliminary exercise, and the final exercise is limited to the authors of the designs thus selected.

The final exercise is a further development of the preliminary problem and is executed in a period of about five weeks. The competitors are permitted to do their work locally, but a statement is required to the effect that the designs submitted in both exercises are the competitor's own conception and that the drawings are the work of his own hand done independently of any school, atelier or architect's office.

The committee selects the best design submitted in the final exercise and recommends its author to the Trustees of the University for appointment to the fellowship. When the quality warrants further grading, First Mention and Second Mention are

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An Alumni Gallery

During a recent discussion in which a number of seniors were taking part, someone mentioned the fact that a certain well known engineer was an Illinois graduate. Nearly all of the other men who were present, revealed their ignorance of the statement in the cries of surprise and gratification which they uttered. Any well informed observer of the gathering might have given vent to exclamations of disgust and chagrin, for the man mentioned was truly a leading figure in the engineering world and certainly the students of his alma mater should have known him.

The above incident only serves to illustrate how true it is that the students do not know the big engineers who are alumni of the College of Engineering. However, the students are not entirely to blame for their ignorance, for they are not given many opportunities to know who the more successful of the alumni are. At some other universities the halls of the engineering buildings are lined with photographs of the more prominent alumni, and below each photograph is printed a line or two telling a little about the man and the work which he has done. As a result the men at these universities know their alumni. They take no little pride in the collection and they eagerly point out those who are the greatest and best known in the profession. Doubtless the photographs serve as an inspiration to many, and probably they have kindled anew the fires of ambition in the hearts of many student engineers.

Our Engineering Hall would take on a new light for all of us if the photographs and a word or two of the history of our prominent alumni were hung on its walls. Such a step should be considered by the faculty of the College of Engineering at once, as it is only through the faculty that such an undertaking could be successfully brought about.

All of the students want to have a knowledge of the alumni, and the plan outlined offers an easy and effectual way of obtaining it. The proposal could be made a reality if the faculty would take the matter in hand and make the necessary requests for information. Let us hope that some action will be taken, and that the end of the school year will see a good number of photographs on the walls of the Engineering Hall.

Neglected by Engineers

At the recent Civil Engineering Senior-Alumni Banquet, Mr. E. S. Nethercut, Secretary of the Western Society of Engineers, spoke of the dearth of good engineer-writers, and stated that never before had the writings of engineers been so poor. Certainly Mr. Nethercut is in a position to know whereof he speaks, and his opinion should be received with grave concern by the engineering world. Practising engineers should give more thought and consideration to the problem of preparing technical papers which will be a credit to themselves and to the profession, and student engineers should fit themselves now for the responsibility which will rest with them in later years of producing good engineering literature, by writing now, and obtaining valuable experience in the preparation and delivery of technical papers.

In our own engineering college, a man is given every possible encouragement to write. The Schaefer Prize is open to all engineering students who have been in college for one year or more; the I. O. Baker Prize for civil engineers requires the preparation of some technical writing; various honorary and professional fraternities require a technical article as a requirement for membership; the student branches of the several American Societies welcome an opportunity to present a student paper to their members; and lastly the *Technograph* is willing and anxious to publish every student article of merit that is written.

The opportunity and stimulus for writing are great, but the rewards for a good paper are even greater. The Schaefer Prize brings to the winner not only a cash reward, but also honor and attention that can be attained in the Engineering College in no other way. The I. O. Baker Prize, which is awarded partly on the technical writings of the winner, will represent the highest honor that a civil engineer may receive. The student branches of the American Societies offer opportunities for wide acquaintanceship, and no little popularity and honor to all who can prepare and deliver an acceptable paper before any of the several bodies. The *Technograph* affords an opportunity for a student to bring his writings to the attention of considerable of the engineering world, and to bring upon himself favorable comment and considerable prominence as a man showing promise of ability and energy.

Opportunity knocks, and the stimulus is there for all of you; the rewards lie waiting, and you are urged to partake of them. The student of today, who will be classed as one of the bigger engineers of tomorrow, is the student who will grasp the opportunity before him, and through his writings bring himself into a position of prominence and esteem before his fellows.

"Snap Out of It"

This fall there seems to be some sort of a lethargy enveloping most of the students in the College of Engineering. Just what it is, is hard to say but certain it is that it exists. The usual large group of interested, willing-to-help students apparently has been supplanted by a group of "do-nothings" or "dead heads."

It is true that not everyone has talents which would make him successful in dramatics, or in politics, or in athletics, or in literary fields, but everyone can devote a little more time to activities going on within the college. The society meetings, lectures and programs are not well attended, and various proposals are not discussed and pushed by the students as they should be.

There are many things in which everyone should be interested, such as, their departmental society, the engineering lectures, engineering open house, the proposed St. Pat's Day celebration, the proposed debate between the College of Engineering and some other college, the *Technograph* and the many departmental functions.

So far this year most of the students have been inactive and disinterested. You, who are in this group, cast off the lethargy, "snap out of it" and show a little life and interest. Come to the society meetings, attend the lectures and display a little interest in college affairs. You owe it to the faculty, to the college and to yourself.

COLLEGE NOTES

ENGINEERS IN ACTIVITIES

In presenting this column of personal items it is the aim of the Technograph to strive to take note of the different fields of student activities in which engineering students are particularly interested. Since it is hardly possible to obtain the name of every engineer in some activity, a number of names may be omitted, but the items are representative of the part taken in University activities by engineers. James W. McMillen is captain of the fighting Illini football team this year. He is known throughout the university life of the country as a great player and leader, and all of us know that he has done much to uphold Illinois on the gridiron. Jim is a senior this year in mining engineering. Wallace W. McIlwain is the faithful Illinois halfback who has done much noteworthy gridiron work last year and this. He will be with us another year in mechanical engineering.

McMillen

Herbert L. Jackel, m.e., '25 is on the football squad this year in position of tackle.

Sydney R. Mayer, c.e., '25, is guard on the squad this year.

G. N. Wickhorst, m.e., '25, is also a guard on the football squad.

C. Sherman, '27, is coming before the footlights in the "San Toy" cast.

J. C. Pighetti, '25, is likewise a member of the "San Toy" cast.

F. B. Powers, e.e., '26, won his '26 numerals for waterbasketball last year. He will probably be a forward on this year's varsity water-basketball team.

C. E. Edmonds, c.e., '26, was captain of the freshmen track team. He is on probation at the present time, but expects to be out this spring for varsity. Among the freshmen last year he won the second highest number of points in the meet.

R. S. Cannon, e.e., '26, is a sophomore interscholastic manager. He was a member of the freshmen cap burning committee and the Illinois Union membership committee.

J. W. Romig, m.e., '24, is a member of the decoration committee for Homecoming and is also on the Dad's Day accommodation committee.

R. J. Rutherford, m.e., '24, is general chairman of the Homecoming committee.

R. D. Webb, m.e., '24, is chairman of the Homecoming decoration committee.

William Gerdes, c.e., '24, is chairman of the Homecoming stamp sales committee, chairman of the social committee, Y. M. C. A. and is chairman of a committee planning a possible St. Pat's day next spring.

H. E. Herting, c.e., '24, is on the Homecoming stamp sales committee.

Ivan Peterson and C. H. Dodge are on the Dad's Day committee.

K. L. Dynes, m.e., '24, is colonel of the R. O. T. C., and a rare soldier he is.

J. R. Scott, m.e., '24, is a prominent member of several Illinois Union committees.

C. P. Johnston, c.e., is a lieutenant-colonel in the engineering unit of the R. O. T. C. He is also senior councilor of the Illinois Union and student member of the Committee on Student Organizations.

H. H. Smith, e.e., '24, is chief operator of the University broadcasting station, WRM.

W. S. Hobbs, m.e., '24, is the representative of the engineering college on the student council.

PRELIMINARY HONORS AWARDED

The banner of scholarship in the College of Engineering has been kept waving during the past two years by fifteen preliminary honor students. The general average made by the fifteen men was 4.63. The electrical engineers head the list with sven men on the honor roll. The fifteen are as follows: R. W. Armstrong, e.e.; W. H. Clingman, e.e.; P. G. Dingledy, g.e.; R. C. Ericson, e.e.; S. B. Hunt, e.e.; R. A. Jascoviâk, e.e.; W. G. Kennedy, e.e.; G. Mican, m.e.; L. A. Mollman, e.e.; R. E. Peterson, m.e.; M. N. Quade, e.e.; B. G. Rich, m.e.; I. D. Sklovsky, m.e.; R. C. Tower, g.e.; and L. Wolinsky, e.e. R. E. Peterson with an average of 4.93 was highest.

The requirements for candidacy for preliminary honors are fifty per cent A, and not more than fifteen per cent C or below. They are awarded at the end of the sophomore year for the first two years' work.

FRATERNITY ACTIVITIES

Tau Beta Pi

Tau Beta Pi, honorary engineering fraternity, elected the following officers to lead it through the present semester: H. E. Wessman, President; G. G. Robinson, Vice-President; G. W. Mattson, Recording Secretary; J. W. Romig, Corresponding Secretary; and L. R. Andrew, Treasurer. Maurice Fahnstock was elected delegate to the annual convention, which was held at the University of Kentucky, on October 18.

At a recent meeting the following men were elected to membership: R. E. Peterson, E. C. Hartman, C. C. Young, Fred Lindvall, P. E. Ormison, H. A. Whitesel, N. W. Rosenstein, H. H. Smith, R. D. Webb, R. E. Schneider, R. E. Hookham and N. A. Tolch. Peterson the highest man in the Junior class, was the only class of '25 man elected. The remainder of the men are seniors.

Theta Tau

Theta Tau, professional engineering fraternity, has been enjoying a successful year so far. Two dinner meetings and a smoker have been held, all of which were well attended. Many guests were present at the smoker which was held at the Phi Kappa Tau house, on the evening of October 18, and everyone present had a pleasant time. At the dinner meetings, short addresses of a professional nature are given by both faculty and student members, on some interesting work with which they are familiar. The following officers are leading the fraternity: C. H. Dodge, President; E. C. Johnson, Vice-President; W. B. Clingman, Secretary; R. B. Sargent, Treasurer; and S. R. Albert Corresponding Secretary.

The following men were pledged to Theta Tau at the regular fall pledging: E. C. Hartman, '24; J. Winkler, '24; M. N. Quade, '25; C. E. Oliver, '25; and W. K. Pierce, '25; of the civil engineering department. H. Arning, '24; G. W. Robinson, '24; C. A. Borgenson, '25; R. Ballard, '25; and O. S. Burnett, '26; of the electrical engineering department. Clifford Strike, '24; R. E. Peterson, '25; and R. J. Stockam, '25; of the mechanical engineering department. O. F. Dowell, '24; R. C. Tower, '25; and A. C. Rehm, '25; of the general engineering department. J. M. Trissol, '25, of the Railway department; H. E. Holmes, '25, of the department of architecture; and H. E. Butters, '25, of the mining department.

Sigma Tau

Sigma Tau held its first meeting of the year on October 16. A. G. Dixon is president; M. S. Angier, Vice-President; J. R. Scott, Recording Secretary; J. W. Smith, Corresponding Secretary; I. E. Boberg, Treasurer, and H. E. Wessman, Historian. There will be no convention held this year, since a bi-annual convention was held last year. Sigma Tau is an Honorary Engineering Fraternity.

STATION WRM

The University of Illinois Broadcasting Station

The University of Illinois is "on the air" this fall with more power and better equipment than was available for the greater part of last season. After being inactive during the summer months, the first program was broadcast from WRM Thursday evening, October 4, when Mr. Joseph Wright, of the Publicity Department, broadcasted University news and announcements, and Prof. James C. Baker gave a talk on "Natural History Museums."

The station is run by the Department of Electrical Engineering, under the general supervision of Prof. E. B. Paine, head of the department. The technical division of the station is in charge of Mr. H. A. Brown, radio instructor in the department. The operator is H. H. Smith, e.e., '24, assisted by J. W. Smith, e.e., '24.

The programs are all arranged by the Department of Publicity, who secure addresses of general interest by different members of the faculty, on some phase of work carried on by the University. Regular programs will be broadcast on Tuesday and Thursday evenings throughout the year. On Tues-

day evenings from 7:00 to 8:00 the regular Student Recitals in the School of Music will be sent out by means of a special wire from the Smith Memorial Music Hall. Later in the evening other features will be arranged. On Thursday evening, at 8:30, University announcements and news to the alumni will be broadcast, with probably a talk by some member of the faculty.

Plans are being made to broadcast games from the new Stadium, commencing with the Homecoming game with Chicago on November 3, by means of special wires connecting the press box with the Electrical Engineering Laboratory. Basketball games will also be broadcast from the Gym Annex, as was done last year.

The station operates on a wavelength of 360 meters, with a power output of approximately 500 watts. Two 250-watt oscillators are used at present, with three similar tubes acting as modulators, using the Heissing constant-current system of modulation.

The voice or music is picked up by means of the microphone, which is similar to that used on ordinary telephones, and passed through from two to five stages of audible frequency power amplification, after which it is applied to the modulator tubes. The latter cause the power output of the two oscillator tubes to fluctuate in accordance with the voice or music, and so reproduce in radio waves the equivalent of the original sounds in the studio.

The power supply for the large tubes is obtained from a motor-generator set giving 2,000 volts direct current for the plate voltage, while the power of speech amplifier is operated from ordinary "B" batteries, except for the last stage, which consists of a 50-watt tube with a 500 volt dynamotor supplying the plate voltage.

When broadcasting from the studio in the E. E. laboratory, only two stages of amplification are necessary, but from Recital Hall, or other points which require sending the program over a telephone line, a portable two-stage speech amplifier is used, which amplifies the voice or music before sending it over the wires.

At present the station is in the experimental stage, improvements being made from time to time. Soon, however, the equipment will be put into more permanent form, and will require little or no adjustment. Permanent provisions will be made for broadcasting from the Auditorium, Chapel, Stadium, and other places on the campus, as the occasion may demand.

Along with the broadcasting, some research work on broadcasting methods and equipment is being conducted in the radio laboratory by Mr. Brown and Mr. C. A. Keener, another instructor in the department. As new improvements are made, these are tried out on the broadcasting station, resulting in more efficient operation and more perfect reproduction of the programs.

Communication has been established with various points in the United States, as well as Havana, Cuba, while reports have come in from as far as New England and Panama.

SCHAEFFER CONTEST

A first prize of $25.00 and a second of $15.00 are being offered again this year by Mr. John V. Schaeffer, for the best papers written on engineering work. The contest closes at 5:00 p. m. on January 7, 1924. Awards will be made soon after the opening of the second semester. No student is entitled to receive the prize more than once.

The essay is to be from 1,500 to 2,500 words in length, and must be written or typewritten by the contestant himself either in legible longhand or on the typewriter. No amanuensis or stenographer may be employed. It must describe some engineering project on which the writer has been personally engaged in some capacity, and shall be accompanied by photographs and freehand sketches made by the writer. It is to be written on one side of standard 8 1-2 by 11 paper with a one and one-fourth inch margin on the left, and with lines as far apart as typewriter single spacing. Each essay must show the name and address of the writer.

The writer must be a student of the University of Illinois beyond his freshman year. The papers will be judged by three persons appointed by the Dean of the College. In making awards, consideration will be given to diction, grammar and spelling, logical arangement, completeness of description, excellence of sketches and photographs, and accuracy of detail.

PHYSICS COLLOQUIUM SUBJECTS

It is the purpose of the Physics Colloquium to take up the recent developments in physics, and to summarize the work being done on the frontier of physical progress. The subjects for lectures can include only those facts which are established and recorded in text-books; they may not cover that portion of our knowledge which is in an experimental stage. Contributions are largely given on original research of members of the University faculty, although at times a lecture may be introduced which will summarize the work of other men. A tentative list of speakers and their subjects for future colloquiums follows:

September 27, Professor A. P. Carman, "Litera-

ture of Physics." Professor J. Kunz, "Account of Trip to California to View the Total Eclipse of the Sun."

October 4, Professor C. T. Knipp, "Positive Rays." Exhibition of Alpha Ray Track Apparatus.

October 11, Dr. E. H. Williams, "Atomic Models and Electrodynamic Repulsion." (Experiments.)

October 18, Mr. L. B. Ham, "Atomic Structure and the Theory of Relativity."

October 25, Dr. W. F. Schultz, "Optometry."

November 1, Mr. K. O. Smith, "Dialectric Constants of Gases, Determined Experimentally by Method of Condenser Discharge."

November 8, Mr. W. M. Young, "Mobility of Ions in the Corona Discharge."

November 15, Professor J. T. Tykociner, "Production of Hertzian Waves by Thermionic Devices."

November 22, Professor A. L. Foley, "Research in Acoustics."

December 6, Report on Chicago meeting of American Physical Society.

December 13, Mr. C. N. Wall, "Measurement of Air Velocity with the Rayleigh Disc."

NEW BULLETINS PROGRESSING

The Engineering Experiment Station which has accomplished so much research work, is preparing to issue three bulletins soon. More will probably be in progress before long.

Bulletin number 137 covers the subject of "The Strength of Concrete, and Its Relation to the Cement Aggregates and Water." It is being prepared by Professors Talbot and Richart, and will be issued this fall.

Profesor Knipp and Professor Brown are completing their bulletin number 138, on the subject of "Alkali Vapour Detector Tubes," a subject in which they have done considerable research. They have brought out a new type of tube which was described in the Technograph last year.

A very mathematical bulletin which will be appreciated by mechanical engineers is being prepared by Professors Goodenough and Fellbeck on the subject of "An Investigation of the Maximum Temperatures and Pressures In the Combustion of Vapours and Fuels." A number of tables and curves will appear in this bulletin, number 139, which will be the most complete report of research work in its line yet published.

Work is still progressing on the Fatigue of Metals Tests and a great deal more than was orginally planned will be done if funds can be arranged for. At least two more bulletins will probably be issued soon.

CONTEMPORARIES

New Steam Auto

The steam automotive power plant is not yet to retire in oblivion. Purdue University, through the School of Mechanical Engineering of the Experiment Station has developed during the past few years a steam power plant of unusual possibilities. The following requirements of satisfactory design have been set and adhered to so far as was possible:

1. The power plant must be light and cheap to build, and compact, and must lend itself to unit arrangement, so as to conform as nearly as possible to conventional automotive design and manufacture.

2. Controls must be made simple and foolproof by an arrangement similar to that used by vehicles using the internal combustion engine. Such an arrangement will facilitate operation and overcome sales resistance.

3. Ideals higher than those that have characterized previous steam plants must be maintained throughout the design so far as boiler life, fire risk, water milage, and similar details are concerned.

The steam generator is of the single tube type, which was found to be most compact. Seamless steel tubing was used, of such a strength as to give a factor of safety of ten in normal operation.

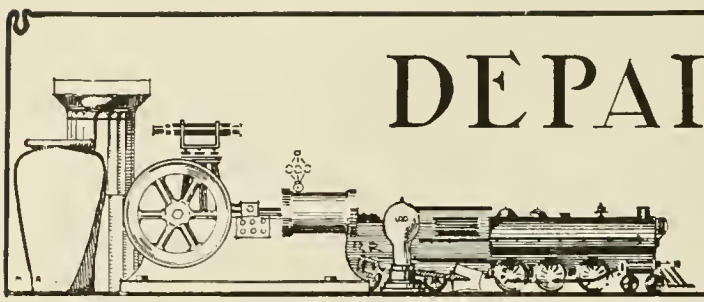
The power plant is of the four cylinder ninety degree V-type. Ball bearings have been used in the construction. Another problem was present in the tendency of water to seep into the crank case and mix with the oil. The difficulty was finally obviated by the use of double bore pistons and cylinder, the lower end being of much smaller diameter than the upper.

It was found that from cold water, steam could be generated and the car started within one minute. All operation is automatic, such as water feed, burner control, etc. If successful in tests which are being made with the car, it will be marketed for public use.

Cultural Courses

"Cultural Courses," an article appearing in "The Tech Engineering News" and written by Professor Enger of our own University, points out the need and relation of non-technical courses to the engineer. To quote directly: "We think of a cultured man as having a keen, well balanced, inquiring and tolerant mind, broad interests, and a large fund of information, an active, sympathetic interest in his fellow men, polished manners, and as being a good conversationalist and writer. The atmos-

(Continued on Page 48)



DEPARTMENTAL NOTES

Architectural News

The Architectural Society

The Architectural Society, under the guidance of President Harrison and faculty advisor La Force Bailey, has a flying start on its way towards a successful year.

The first smoker was a "real party" and about the largest turnout of men on record witnessed the coronation of Professor Provine. Professor Provine was crowned king of the meeting rather against his will and a little physical suasion was necessary before he would accept the honor. Under his reign the architects were instructed in something besides design and construction, namely, boxing and wrestling. An excellent wrestling match and a fast boxing bout were features of the evening. Dave Kosvich "strutted his stuff" for the boys and sang "seven come eleven." Food for the soul was furnished by Bill Donahue's Orchestra, while food for the body, cider and doughnuts, were being consumed.

The object of the Society, besides its customary duties of promoting the Year Book, the Fete, and special exhibits, is to give its members the opportunity for broadening their educations through the medium of lectures, both on technical and non-technical subjects. The Society has been especially fortunate in obtaining such men as Mr. Hewitt of Peoria, and Mr. Willis of Champaign, as lecturers. These lectures will take place on November 1, and December 6, respectively.

Department News

This year the Architectural Department is continuing its Beaux Arts Institute of Design work on a larger scale, as the sophomore and junior classes are also taking the work. The seniors did exceptionally well last semester in the New York judgments, although they were handicapped by lack of experience in Beaux Arts work. The results should be even more satisfactory now that the department is acquainted with this type of work.

The Ricker Prize of $25, given by the Alpha Rho Chi fraternity, was won last semester by Oliver Stephan. His subject was, "English Open Timber Roofs of the Middle Ages." The second prize of $15 was awarded to Ray Smith and the third prize of $10 to Harford Field.

Scarab

The first problem that confronts the Scarab Fraternity is the slight re-arrangement of the traditional Scarab Medal Competition, as the Beaux Arts Design work makes it impossible for the sophomore and junior classes to take the same problem at the same time. The new plan has not yet been decided upon and so will be announced later.

The Scarab Traveling Exhibit appeared here late last semester and so was not generally appreciated. It was unfortunate that the exhibit did not arrive on schedule as it contained an excellent collection of sketches.

Alpha Rho Chi Activities

The biggest Homecoming in the history of the University is planned for this year. Many of the alumni of the Department of Architecture will be on hand to take part in the festivities. Anthemios, of Alpha Rho Chi, expects to entertain a goodly portion of these. At Homecoming, programs for a competition for the design of a new chapter house will be given out. The results of this competition should give Alpha Rho Chi plans for a house of distinctive character which will be erected on the campus within a short term of years.

The chapter is concerned with the new men of the Department, as well as the old. During registration week, a "Smoker" for the Freshmen was given at the chapter house. Several prominent members of the faculty spoke a few words of advice to the new men with the air of good fellowship which pervades the department.

Gargoyle Activities

Gargoyle started the year with an early meeting and an active program. The officers for the coming semester are: R. J. Pfeifer, President; Tom D. Cooke, Vice-president; G. M. Scudder, Secretary; W. M. Pearson, Corresponding Secretary; G. B. Young, Treasurer.

The Society plans something new which will be of particular interest to the Freshmen. The plan will be announced later.

Two papers placing high in the Ricker Prize Competition in Architectural History have been read in the meetings and several more will be read this semester.

Ceramic News

A. S. Cer. E. Activities

The student branch of the American Ceramic Society commenced the semester, October 4, with a smoker at the Union Building. G. S. Smallwood, chairman of the Society, presided, while S. Q. Lee was acting secretary-treasurer due to the withdrawal of Caldwell from the Ceramics school, this semester. R. H. Louden '24, was unanimously elected to fill the vacancy..

The excitement commenced with a spirited three round boxing match by two of Paul Prehn's proteges, Smith and Rainey. The instructors, old and new, were then introduced. Mr. Ray Watson, graduate of Ceramics at Ohio State University in '18, was presented as a new member of the Ceramics Department. After the new men had been given a "standing" introduction to their future instructors and fellow "bricklayers," the meeting was adjourned.

Refreshments, consisting of milk and doughnuts, were served at the mixer which followed the meeting.

Department Notes

The new round, up or down draft kiln, of 5 1-2 feet inside diameter, has been put into service in the kiln laboratory of the Ceramics Engineering Department. This kiln is arranged for coal or oil firing and is equipped with automatic stokers presented by the Clay Service Corporation of Chicago.

Keramos Activities

Commencing last year, Keramos, honorary ceramic society, decided to give a prize to the sophomore ceramist having the highest scholastic average for his freshman year. The prize consists of a one year subscription to the American Society of Ceramic Engineers and a one year subscription to Transactions. Two men, H. L. Northam and L. B. Gardner, were tied for honors last year.

Civil Engineering

Department News

On October 10, an assembly of the civil engineering students was held in room 221 Eng. Hall at 4:00 p. m. and several matters of interest were explained by Professor Williams, head of the C. E. Department. The potential value of the new civil engineering labatory for advanced research was stressed. The attention of the students was also called to the graduate courses in civil engineering now being offered at the University. Professor Williams then explained the details of the I. O. Baker Prizes and the Schaeffer Prizes.

I. O. Baker Prize

I. O. Baker, Professor Emeritus of Civil Engineering, has created a fund giving an income for two annual prizes to senior civil engineering students. The first prize is $75 and the second prize is $25. These prizes will be awarded to those seniors making the highest average under the following system of scoring:

Scholarship	70%
Authorship of technical articles	10%
Activity in technical organizations	10%
General characteristics	10%
Total,	100%

In addition to the prizes, the winning students will have their names engraved upon the bronze tablet now hanging in the corridor of the second floor of Engineering Hall and will also receive a certificate of award.

These prizes should do much toward setting up the ideal of worthy accomplishment in the minds of every civil engineering student at the University of Illinois. Professor Baker deserves the appreciation and thanks of all for the highly practical stimulus he has placed before us.

After the explanation of the prizes, Professor Williams called upon Professor Baker for a short closing talk. Responding with his characteristic vigor, Dr. Baker inspiringly emphasized the value of setting an ideal and fighting for the accomplishment of that ideal.

Personal Notes

We have two new graduate assistants with us this year, J. M. Hardesty '23, University of Texas, and George Keranen '23, Washington State College. Both are civil engineering graduates and are specializing in structures. Mr. Hardesty has had considerable experience in highway work. Mr. Keranen has seen service in the Forestry Department and has also mixed in highway construction.

L. G. Straub '23, F. G. Bruckman '23, both of U. of I. and L. E. Grinter '23, U. of Kansas, are enrolled for graduate work in Structural Engineering.

A new mechanician, Wm. T. Pope, has been added to the staff of the C. E. Department. Mr. Pope will assist in the laboratory on apparatus and on the preparation of specimens.

A. S. C. E. Activities

One hundred and twenty "would-be" engineers

turned out for the A. S. C. E. get-together, held in room 221 Engineering Hall, on Tuesday evening, October 2. President Boberg opened the program with a few words of welcome and an appeal for co-operation within the society. "C²" Williams, our chief, outlined some mighty good reasons why the engineering student should take part in the activities of the society representing his particular branch of engineering. Professor Babbitt, of the M. & S. E. Department, tried to impress upon us that the "sewer rats" are on a par with civil engineers. Mr. C. K. Mathews told us that a knowledge of surveying was essential in the drug business. At least, the point was well taken. Mr. R. S. Crossman of the G. E. D. Department, closed the verbal bombardment, and the assembly adjourned for doughnuts and cider. The beginning augurs well for a successful year for the A. S. C. E.

Chi Epsilon Activities

Chi Epsilon, honorary civil engineering fraternity, has held several interesting meetings this year, and the chances for a most successful year are bright. The following officers were elected last June: J. B. Clausen, President; H. E. Wessman, Vice-President; H. E. Herting, Secretary; and E. C. Hartman, Treasurer.

The following men were pledged this fall: J. Robert Welsh, '24; M. N. Quade, T. W. Oliver, T. W. Schroeder, L. C. Riggle, S. S. Ball, E. C. Norwood, W. K. Pierce, C. V. Erickson and Iver Erickson, all of the class of '25.

Electrical Engineering News

Department News

The returning E. E.'s found that the interior of the laboratory had been changed somewhat during the summer in order to make room for the new machines. The 45 K. W. motor-generator set has been moved from its old location and direct coupled. The space thus made available is occupied by another platform. New machines are steadily arriving while those already added and in place are as follows: 2 General Electric D. C. motor-generator sets rated at 7 K. W. for use with 110-220 volts, and one General Electric revolving field alternator of 8 K. W. capacity, at 220 volts, driven by a D. C. motor. This alternator is provided with an Amortisseur winding so that it can be started as an induction motor. A new G. E., 6 phase, 60 cycle, 10 KVA rotary converter and control board have been installed on the west side of the laboratory. This converter embodies the latest improvements in the design of this type of machine. The laboratory power has been divided into two parts with each circuit operating through a set of Automatic Reclosing Circuit Breakers. With this arrangement trouble at one end of the "lab" does not stop every test going on at that time.

Professor Morgan Brooks has returned from a year's travel in Europe. Among the places he visited were France, Italy, Switzerland, and the northern part of Africa. While traveling Professor Brooks studied the large hydro-electric plants in these countries and also the electrification of the railways. Switzerland seems to lead in electrified railroads as it is nearly completely converted. However, the fact that the country is so small does not place it ahead of the United States in actual miles of electric railroad. In fact, our country probably has a greater mileage of railroad electrification, although it is of course, widely scattered.

The E. E. Society commenced the year with its usual pep and enthusiasm the Friday night after registration. The first meeting was a get-together and the crowd was the largest on record even for a meeting featuring the renowned E. E. Society 'eats.' About 250 men were present and after running the machines and looking around they listened to the worthy efforts of the speakers. The eats were highly appreciated and uniquely announced by an electric sign at the end of the laboratory. The E. E. Show, to be given next spring, formed the chief topic of the speeches and the talk around the lab. The show, which is given every two years, has the reputation of being the best of its kind in the country. The Electrical Show at Illinois is, or at least has been, the pattern used by other universities in modelling their shows. The show this year is expected to surpass any entertainment of years, both in size and originality. The first concrete development of the plans came with the appointment of the various managers by C. T. Parker '24, at the second meeting of the E. E. Society. The staff appointed is as follows:

C. T. Parker, General Manager; G. G. Robinson, Chief Engineer; N. E. Sowers, Engineer of Stunts; H. H. Smith, Engineer of Radio; J. W. Smith, Assistant; J. W. Hart, Manager of Commercial Exhibits; J. C. Rettenmeyer, Chief of Electricians; E. K. Shively, Assistant; J. T. Jackson, Business Manager; F. Lindvahl, Display Manager; S. B. Hunt, Assistant; V. F. Buddeke, Purchasing Agent; M. S. Angier, Advertising Manager; D. E. Kreuger, Assistant; L. Warren, Assistant; R. J. Crandall, Treasurer.

Eta Kappa Nu

Eta Kappa Nu, honorary electrical engineering fraternity, has started a year which should be successful in every way. The pledges for the first semester are:

F. Lindvahl '24, G. W. Robinson '24, H. A. Whitesel '24, R. O. Askey '25, H. A. Bartling '25 C. A. Borgeson '25, W. H. Clingman '25, R. C. Ericson '25, S. B. Hunt '25, R. A. Jascoviak '25, W. G. Kennedy '25, L. A. Mollman '25.

Mechanical Engineering News

A. S. M. E. Activities

On October 12, 1923, The American Association of Mechanical Engineers gave a smoker in the Mechanical Laboratory. Professor A. C. Willard, head of the department, gave an illustrated lecture on the Hudson River Vehicular Tunnel. The general features of the tunnel and the methods of construction were described. The A. S. M. E. smoker was held particularly to interest student engineers in joining the organization and to provide for a general get-together between the faculty and students.

Department Notes

Forge Shop. The forge laboratory of the Mechanical Engineering Department has been entirely rearranged this year. The furnaces are now located in a group in the heat treatment room, opposite the new forge laboratory offices. Adjacent to the battery of furnaces, a physical laboratory has been laid out in which the student may test heat treated materials on the Brinell and Sceleroscope machines. In order that the structure of steels may be more closely observed by the student, a new microscope has been ordered by the Department. This, together with a new pyrometer and a new high temperature furnace, completes the additional equipment this year.

Foundry. In the foundry division of the Mechanical Engineering Department, several new machines have been installed this year. All the new equipment is to be operated by students studying foundry courses. The Jolt Stripper machine, a product of the Osborn Manufacturing Company, is to be used in connection with the Tabor Stripper machine. The Jolt Stripper will produce the cope, or the upper part of the flask, and the Tabor machine will produce the drag, or lower part of the flask. Both machines automatically ram the sand and draw the patterns. The foundry department staff intends to put the production of castings on a commercial basis, that is, to produce by means of machines and unskilled labor, that which poorer machines and skilled labor would ordinarily be expected to produce. The two machines will be used principally in the production of flywheel, crank case, and cylinder block castings for the gas engine parts which will later be machined by the students in the machine shop laboratory.

A new International molding machine of the roll-over, pattern draw type, is to be used in the foundry laboratory in the production of andiron castings this year.

A new Rotating Sand Blast Tumbling Barrel has been installed in the basement of the foundry laboratory. The machine is a product of the Standard Equipment Company and is to be used in "tumbling" the production castings of the gasoline engines, manufactured by the students. The surfaces of new castings are covered with sand and scale when taken from the mold, so the purpose of the tumbling barrel is to blow an abrasive material, such as sand, against the casting with a high velocity, thereby cleaning the casting. This process puts the casting in shape for the machine work to follow. An ingenious method is used for the disposal of dust that results from the breaking up of the sand particles. The dust is sucked by a small fan through a pipe into a dust reservoir, which is run by a 1-2 horsepower motor. The heavier particles of sand sink to the bottom of the reservoir, while the very fine dust rises to the top and escapes through a pipe leading outdoors. The tumbling barrel is turned by a one horsepower motor.

Machine Shop. Two dynamometers, one for a lathe and one for a milling machine, have been designed for the machine laboratory. By means of these specially designed dynamometers, all the forces that act in a lathe, or a milling machine, may be accurately measured together with their time of action. Research in machine work, is practically unknown in the average industrial plant. With the accurate compilation of data made possible by these dynamometers some new information concerning the relative cutting speeds of steel will soon be available.

Vincente S. Fuentes, a mechanical engineer of the class of '23, recently left the University to take a position with Frick and Company, of Pennsylvania.

A series of notes on the design of steam power plants have recently been compiled by Professor C. A. Leutwiler of the Department of Mechanical Engineering. These notes are to be used only by students who are registered in design courses.

Rumualdo Araneta, '23, a mechanical engineering graduate, has returned to his home in the Philipine Islands where he expects to enter the sugar business.

Mr. Carl H. Casberg, successor to Mr. Gustov H. Radebaugh, as superintendent of the machine shop laboratory, graduated from the University of Wisconsin in 1916 with the degree of Bachelor of Science in Mechanical Engineering. Mr. Casberg

served the next five years as Assistant General Superintendent for the Rockford Drilling Machine Co., Rockford, Illinois. Before joining the University staff, Mr. Casberg taught Mechanical Drawing, Mathematics, and Machine Shop Practice in the Rockford Continuation School and in Rockford High School.

Mr. H. O. Haughton, assistant superintendent of the foundry laboratory, graduated from Sheffield Scientific School, Yale University, with the degree of Bachelor of Philosophy, in June, 1919. Mr. Haughton spent the next four years with the Westinghouse Electric and Manufacturing Company at the South Philadelphia Works. His practical experience was gained in the foundry and machine shop, in the scheduling department, and as assistant to the general foreman. Mr. Haughton was also employed for a short time in the Engineering Department of the American Locomotive Company at Schenectady, N. Y.

A. S. M. E. Scholarship

The attention of all mechanical engineering students is called to the fact that each year, under the authority of the governing bodies of Columbia University, the American Society of Mechanical Engineers has been granted the privilege of naming the recipient of a scholarship in mechanical engineering in the schools of Mines, Engineering, and Chemistry at Columbia University.

The purpose of this advance course is to turn out a higher type of engineer, trained in the humanities as well as the fundamentals of his profession.

The scholarship is awarded for graduate study at Columbia University, to a student having had three years study at a recognized technical institution, or to a student possessing a Bachelor of Science degree. The scholarship amounts to about $350.00, depending upon the courses studied. The candidate is admitted on the basis of his previous collegiate record without undergoing special examinations.

Further information may be obtained by communicating with either the National Secretary of the American Society of Mechanical Engineers, or with the Secretary of Columbia University.

Pi Tau Sigma Activities

On September 28, 1923, Pi Tau Sigma gave a freshman smoker at the Mechanical Engineering Laboratory. After short talks by Professor A. C. Willard, head of the Mechanical Engineering Department, G. A. Goodenough, R. D. Webb, and T. E. With, President of the Society, the men formed in line and were introduced to their future instructors.

Pi Tau Sigma, honorary mechanical engineering fraternity, will present a polyphase-duplex slide rule to the M. E. freshman with the highest scholastic average for the year. In case of a tie for honors, the man most interested in campus activities will be given the preference. Pi Tau Sigma, in giving the prize, hopes to stimulate interest in the attainment of high scholarship among the first year men.

Mining Engineering News

Mining Society

The first Mining smoker of the year was held Wednesday evening, October 3, and if it's success is any indicator, a most successful year is ahead of us. Fully 80 per cent of the Mining Department turned out. In a short preliminary "business before pleasure" talk, President Dodge welcomed the freshmen and new students, and presented the business of the meeting. Several committees were appointed, among them a memorial committee to complete the work of a memorial for Professor Stoek,founder of the Mining School at the University of Illinois. A few other matters of business were brought up, after which refreshments were served (with music). Talks by the faculty, which were the most interesting part of the program, came last. The interesting and varied experiences of Professors Drucker and Bains, and short talks by Smith and Fraser were greeted with enthusiasm. By 8:45 the talks were over and the doughnuts were gone, so the meeting closed with every miner more firmly convinced than ever of the advantages of being "one of the boys" in the big family—a little college in a big University.

A novel innovation was introduced by President Dodge—a sort of mutual, individual introduction—in which every member introduced himself to the others present, with a few words of his history. It proved a great success.

President Dodge and the program committee have promised us some interesting evenings in the future, in the form of lectures by various prominent men. The activities of the Mining Society this year bid fair to eclipse, by far, even the successes of last year. The spirit of progressiveness and good fellowship, shown thus far, is more than encouraging.

Thursday evening, October 11, the Mining Society, and a number of guests, met in 100 Commerce and were addressed by Professor Parr, of the department of Chemistry, on "The By-Products of Coal Coking." President Dodge had promised us an instructive evening, and his promise was more than fulfilled, for Professor Parr's illustrated talk was interesting as well as instructive.

A short business meeting was held. The mem-

bership committee presented a plan calculated to make every miner a member of the Mining Society. A report on the progress of the committee in charge of Prof. Stoek's memorial was given. Definite progress is being made, and Lorado Taft is to be asked to do the work. Mr. Taft was a personal friend of Professor Stoek. H. E. Butters, '25, was elected Secretary-Treasurer of the Mining Society for the ensuing year.

The Senior Inspection Trip

On October 25 a class of thirteen seniors and two graduate students, accompanied by Professor Drucker and Mr. Smith left on the mining inspection trip. Their scheduled stops were chiefly in southern Illinois and south-eastern Missouri in the lead and coal mining districts.

One of the most interesting stops during the trip was made at Flat River, in south-eastern Missouri, where they visited the lead mines. The two largest lead mines in the world are located here, producing one-third of the lead mined in the United States. There are miles of passages underground, through huge rooms, some of which are 80 feet high, from which the lead is being taken.

From the lead district they returned to Illinois and inspected a number of the largest and best equipped coal mines. The inspection "crew" visited the "Orient" mine, the largest coal mine in the world; the "Kathleen" mine, where the skips were inspected; and the Jackson Coal Company's mine at Hallidayboro, which is still using the old cable system of underground haulage.

A number of ideas obtained on the trip are to be incorporated in the problems in Mining Design which the seniors are working on. The party returned October 31, after a trip of seven days duration.

The U. S. Mine Rescue Car

Professor Hoskin has succeeded in his efforts to have a U. S. Mine Rescue Car sent to the University. He has been trying for several years and this year the Government consented for the first time.

The United States maintains a number of Mine Rescue cars scattered through-out the country, to be reasonably near in case of a mine disaster. Each car carries a crew of highly trained men and the finest and most efficient rescue apparatus obtainable. On November 5, the car assigned to this district will arrive here, and will occupy the siding back of the Transportation Building. The senior Mining Engineers studying Mining 8 will report to the car every day for the week or ten days of its stay and will take a very intensive course of study and training from the crew of the car. At the end of this time the class will take an examination, and those passing it will obtain certificates entitling them to take charge of similar work in any mine in the country.

It is hoped that the car will return each succeeding year in order to enable future classes to have the opportunities of this instruction. Professor Hoskin has done a great deal for the miners in securing this car and every eligible student will take the utmost advantage of it.

Mining Engineering, as a profession, is becoming more and more inviting every year. The recent recognition of Mexico affords exceptional opportunities for young mining engineers. The mineral mining industry is improving rapidly. American capital is venturing in considerable amounts into South America and the far East and this alone will require many young graduates in the future. The initial salaries of $125.00 to $150.00 a month are recognized to be merely starters, as the letters which Professor Drucker has received from nearly all of the graduates, indicate. They are all satisfied with their work and can see real opportunities ahead. The profession of Mining and Metallurgical Engineering is a well paid one for those who apply themselves thoroughly.

There are 52 enrolled in the Department of Mining Engineering. We have the same number of Freshmen as last year, the senior class is larger this year than last and the junior class is exceptionally large. The increased enrollment is already noticeable; the tight has just begun, and year by year Illinois is advancing step by step to the head of the list of Mining Colleges, the position which we think she should and will in time occupy.

Mining Department News

Mr. Thomas Fraser, formerly of the U. S. Bureau of Mines, has recently been appointed Research Assistant Professor of Mining Engineering. For the past five years Mr. Fraser has been actively engaged with the Bureau of Mines Experiment Station here at the University, carrying out investigations in coal washing, and, in co-operation with Mr. Yancey, he has produced numerous pamphlets telling of the results of their investigations. Fraser and Yancey have built up quite a national reputation, and their work is becoming well known in this field. Mr. Fraser is now completing a problem, started by Professor Hoskin, regarding the distribution and cost of mining power, and he is also starting a new problem on the ventilation of mines. Mr. Fraser graduated from the University of Illinois, and obtained his E. M. degree in '17. The department is indeed fortunate in obtaining his services.

Mr. Smith has been promoted, and is now a full

instructor in Mining Engineering. He graduated from the University of Illinois in '19, and entered the teaching staff in September, '21.

Professor Bains, for the past few years, has been doing consulting work in connection with a Silica mill for a New York firm and has been employed during the summer designing this plant. Professor Bains also erected an electric furnace for the production of Ferro-Silicon, to be used in iron and steel and in the treatment of zinc ores. He was formerly Associate Professor at the Rolla School of Mines, and at the University of Montana. He is a graduate of Cornell University and of the school of Mining Engineering at Columbia University, and is a well known authority on electrothermic metallurgy. Professor Bains' family has recently moved from California to make their home here.

Professor Drucker spent the months of June and July in collecting and preparing material for the book he is writing, "The Economics of Metallurgy," a book of problems for senior students in Mining Engineering. The month of August he spent with his wife at Portage Lake, in Northern Michigan. Professor Drucker gave a great deal of his time during the month of June in securing employment for last year's graduates. Of the graduating class of 10, 8 were placed in positions in South America, Nevada, Colorado, Montana, Arizona and Illinois, at beginning salaries ranging from $125.00 to $250.00 a month. There were additional applications from Mexico and the West which could not be filled, owing to a lack of graduates. The work of the Department, and especially of Professor Drucker, in this connection, is greatly appreciated by the graduating senior classes.

The School of Mines at The University of Illinois is achieving a world-wide reputation. Mr. Moses has been sent here by the South African Government to work for his M. S. degree in Mining Engineering Mr. Moses is a graduate of Transvaal University, and is specializing in coal mining for graduate work.

Mr. T. Banno a graduate in Mining Engineering of Waseda University, Tokio, is sent here by one of the largest mining companies in Japan to take the coal mining courses which are offered. Mr. Banno expects to complete his studies in one and one-half years, graduating from the coal mining option with a degree of M. S. in mining.

Mr. Cadoval, a graduate of the University of Texas in chemical engineering, has entered the Ore Mining Department. He is taking the metal mining option, specializing in metallurgy.

The Mining Department has received about a hundred valuable specimens of ores and minerals from the Rocky Mountain districts, donated by Mr. A. N. Sweet, student of mining at the Colorado School of Mines. Professor Hoskin also has a valuable collection of gold and native silver ores which he gathered during the past summer. The district from which the ores were obtained is apparently a "coming" one, and a few years may see Illinois graduates figuring in its development.

Professor Hoskin spent the summer making mine examinations in the Cascade Mountains of northern Washington, in the old Garfield mining district in central Colorado, and in the northern Ontario gold-mining field. The specimens he found were gathered during these examinations.

Delta Mu Epsilon Activities

Delta Mu Epsilon, honorary mining engineering fraternity, announces the pledging of the following men: R. A. Podesta '24, G. L. Smith '24, R. L. Jacobs '24, J. Setinsky '24, B. L. Lubelsky '24, R. L. Fleming '24, H. E. Butters '25, J. A. Blair '25, J. W. Schaefer '25.

The following officers were elected: N. A. Tolch '24, president; B. C. McCowan '24, secretary; C. H. Dodge '24, treasurer.

Railway News

Railway Club

The first meeting of the Railway Club was held on Thursday, October 4, with its purpose, to discuss plans for the year. The programs to be arranged will probably include the showing of a film made by the Baldwin Locomotive works on locomotive construction. Speakers from out of the city will be obtained at later dates. It is the endeavor of the Club to band all railway engineers together in an organization that can be helpful and useful to each member by discussion of railroads and other common problems.

The second meeting was a smoker held at the Union Building two weeks later. Officers this year are: President, C. E. Sperry; Vice-president, R. W. Brady; Secretary, I. V. Cohen; and Treasurer, F. W. Copp.

The Railway Club held its 12th annual smoker Thursday, October 18. Considering the inclement weather the showing was all that could be expected. Although one of the smaller Engineering Societies, the Club is beginning its twelfth successful year. Professor Schmidt told about the first club and the work of the club in general.

Rain never does keep a good man down for Professor Knight was present as full of good jokes as ever. Vice-president Brady offered a rebuttal to Professor Knight's talk. No decision was given.

(Continued on Page 44)

Co-ed: Why do they call it the weeping willow? It doesn't weep, does it?

Ed: No, it used to but one day the fir tree said to it "pine knot."

—*Gargoyle.*

"As you were," said Mary Jane assisting her roommate in removing cosmetics and taking off false curls.

"Whar did you get that fine hat?"

"At de sto'."

"How much wus it?"

"Ah don't know. De sto'-keeper wasn't dar."

"Oh, Sarah dear," her mother said,
"That man had better go."
"Oh, mother dear, please, not just yet—
He works so doggone slow."

—*Punch Bowl.*

AT LEAST

"Leave me with a smile," murmered the victim as the yegg frisked his clothes.

A PROMISING ENGINEER

First Prof: There's a lad with good stuff in him.

Second Prof: Let's follow him; maybe we can find out where he got it.

WELL?

"This," said the very foolish person as he removed his ear from the very fair person's hairnet, "is what I might term an entangling alliance."

SO SAY ALL OF US

Prisoner: Thank you Judge, for the sentence.

Judge: Why thank me? I gave you sixty days.

Prisoner: After I heard my lawyer speak I thought you would give me life.

Sam, a colored "slicker," sold Mose a mule. A few days later Mose told Sam the mule was blind.

"Whut makes yo' tink dat mule is blind?"

"Why, I turned him loose in a field and he ran right into a tree."

"Mose, dat mule ain't blind. He just don't give a damn."

—*Exchange.*

"Oscar, gimme three cigars," ordered Bill Allen as he pitched a quarter across the counter.

"Strong ones, or mild?"

"Gimme the strong ones. The weak ones are always busting in me pocket."

"You've no kick coming," said the polite dispenser as he handed the customer a glass of near beer.

IN THE LIBRARY

Sing a song of nuts and bolts,
Of rivet heads and screws;
Entertain yon engineer,
He's got them "Slipstick blues."

PROOF

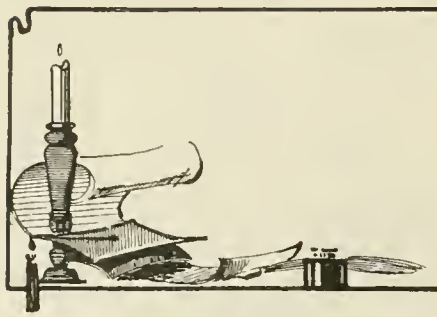
Professor: "Isn't it wonderful, my dear, they actually found in Tutankhamen's tomb couches and chairs thirty centuries old, and in good condition."

His Wife: "I have always said, John that it pays in the long run to buy the best."

HOW YA GONNA KEEP IT?

"We-ell, maybe I could give ye a job as a time-keeper," J. McGarrity, Contractor and Building, remarked doubtedly to the ne'er-do-well son of his dead friend.

"Why-why-I'm much obliged, but the fact is, the pawn-broker's got my watch," stammered the young prodigal.



ALUMNI NOTES

Robert E. Doherty, c.e., '09, has just been named as one of the consulting engineers of the General Electric Company, a group composed of the most prominent engineers in the service of the compan.

Following his graduation, Mr. Doherty entered the Testing Department (Students' Training Course) at the Pittsfield Works of the Company, and in 1910, was transferred to the A. C. Engineering Department at Schnectady. In 1920, he was made assistant to the late Dr. Charles P. Steinmetz, with whom he was associated until appointed to the position mentioned. As a consulting engineer, he will be engaged on engineering problems incident to the company's work. In addition to this he has supervision of a three-year course of training for young engineers connected with the company, the purpose of which is to give intensive training in designing engineering.

Mr. Doherty, who received a master's degree from Union College in 1921, is well known throughout the electrical engineering profession, and has read several papers at national conventions of the American Institute of Electrical Engineers, of which he is a member. His appointment as a consulting engineering is a distinct tribute to his standing in the profession, as out of all the engineers in the General Electric Company organization there are at present but fifteen consulting engineers, each of whom has won distinction in some particular field of electrical engineering.

Mr. Doherty is a member of Theta Delta Chi, and of Tau Beta Pi, Sigma Xi, and Eta Kappa Nu. He was a member of the University band, a member of the Cap and Gown Committee, and chairman of the Senior Hat Committee.

J. A. Ockerson, c.e., '73 who is practising civil engineering at St. Louis, is chairman of five of the standing committees of the Mississippi River Commission.

W. F. Kendall, c.e., '85, of New Orleans is also with the Mississippi River Commission. Previous to this he was with the Southern Pacific, engaged in railway work.

James M. Kent, *m.e.*, '85, is at the Manuel Training High School in Kansas City teaching civil and electrical engineering.

A. T. North, a.e., '85, is an associate editor of the "American Architect."

T. H. Amrine, e.e., '06, was in Japan for the International General Electric Co. He was reported as being lost in the recent earthquake there.

Chas. Nolte, m.e., '09, has the important position of general manager for the Robert Hunt Company, engineers, of Chicago.

E. C. McMillen, m.e., '09, is located with the Kalman Steel Co., at their offices in Chicago.

Kenneth Talbot, c.e., '09, who is with the Koehring Co., of Milwaukee, is responsible for some discussions in the *Engineering News-Record* concerning sales methods used by equipment manufacturers.

B. A. Horn, arch., '10, is one of the partners of the architectural firm of Cervin and Horn of Rock Island. They have received honorable mention in a recent international contest for the design of a hospital.

H. M. Butt, c.e., '14, is located at Gilson, Ill., and is doing private engineering work at Galesburg and Monmouth.

W. L. Nichols, c.e., '15, is now an assistant engineer for the New York Central. His headquarters are at Cleveland.

C. M. Clark, r.m.e., '17, is connected with the motive power department of the Chicago and Northwestern.

Elwyn Simmons, a.e., '20, is the building construction superintendent for the Simmons-Dick company of Chicago. 'Runt' was football manager while in his senior year in school.

Harry Soderberg, a.e., '20, is now vice-president and plant superintendent of the Los Angeles Concrete Tile Co.

C. L. Conrad, e.e., '22, is connected with the General Electric Co.

Clara Nicolett, m.e., ('22) received some prominence in the form of a page write-up, illustrated, in the Literary Digest. She is in the Missouri River power plant of the Kansas City railways.

R. W. Schmidt, c.e., '22 is now in St. Louis working for Flad and Humphries, engineers.

C. C. Smith, e.e., '22, is with the Commonwealth Edison Co., in Chicago.

Jack Thompson, e.e., '22, is in the engineering department of the Illinois Central lines.

Howard Main, e.e., '22, has just been made chief engineer of the Wabash, Chester and Western with his headquarters at Mt. Vernon.

C. L. Eddy, e.e., '00, is in charge of the railway engineering department of the Case School of Applied Science at Cleveland. He has lately been made treasurer of the school.

A. E. Horst, m.e., '11, who is contracting in Rock Island, recently prepared a paper on trucks for road construction, for the American Road-Builders Association.

E. J. Rossback, min., '12, is in Paris France, as the Foreign representative of the Sullivan Machinery Co., of Chicago.

G. S. Sangdall, e.e., '13, manages the Montreal office of the Chicago Bridge and Iron Works.

Ralph G. Perry, min., '15, is doing his bit to keep the country warm. He is the resident engineer of the Republic Coal Co., at Roundup, Mont.

John D. Mallison, e.e., '15, is assistant highway engineer of the Fourth District at Peoria.

A. M. Barreau, a.e., '15, is a structural engineer for the firm of Byllesby and Co., of Chicago.

J. W. Armstrong, e.e., '93, received his diploma with the Class of '22. While in school he was on the football team and was also somewhat of a track man. At present he is the Vice-president of the Illinois Oil Company at Rock Island.

J. H. Westbay, r.m.e., '17, is a special engineer for the Big Four. His work is in the transportation department where he is interested in fuel conservation of power plants.

Col. W. R. Roberts, e.e., '88 is president of Roberts and Schaefer, engineers and contractors of Chicago. He holds a chairmanship in the American Mining Congress and has written an article on the adoption of standards for American industries, which was published in the *Mining Congress Journal*.

F. L. Steinhoff, cer.e., '17, edits a new ceramics publication, '*Ceramics Industry*.' Others on the staff are: *G. W. Reed*, '22; *R. R. Danielson*, '14; *A. E. Williams*, '10; *M. C. Booze*, '15; and *C. C. Treischel*, '16.

Rexford Newcomb, arch., '11, of the University Department of Architecture had an article in a recent number of the *Western Architect*. He is now engaged in writing texts on the History of Architecture to be used in the department.

Paul Becker, m.e., '17, is with the Westchester Lighting Co., Mt. Vernon, N. Y., as assistant engineer.

W. B. Overbee, e.e., '21, is with the Illinois Bell Telephone Co., at Chicago. Other Illinois men with the company are: *R. N. Dawson*, '20; and *'Red' Burnell*, '21.

Rodney Bell, e.e., '09, is building state roads near Paris.

R. E. Tully, e.e., '13, is teaching military science at Washington University. He has just recently returned from the Canal Zone where he has been stationed for the past two years.

L. C. Herwig, e.e., '22, has just returned to the States from South America after an eighteen months stay with the Sun Oil Co.

The General Electric Company has enrolled in it's Student's Training Course at Schenectady, *M. W. Kenny*, *R. C. Ruedy*, *R. E. Welton* and *D. O. Whelan* of the Class of '23.

E. F. Carpenter, and *Harry Gjessing*, min.e., '23, are with the Tom Boy Gold Mine in Colorado. In a letter to Prof. Drucker, both seem to be climbing right along in their profession.

R. S. Sanford, min.e., '23, migrated to Columbia where he is employed as a metallurgist for the Columbian Gold Mining Corp.

E. C. Prouty, e.e., '14, has joined the staff of *Power Plant Engineering*. He was formerly subscription manager for the McGraw-Hill publications.

E. K. Burton, e.e., '11, is now resident manager for the Trussed Concrete Steel Co., in San Juan, Porto Rico.

Roy C. Mitchell, a.e., '06, has come into print in connection with a description of concrete trusses and girders which are among the largest ever used in building construction.

F. A. Lorenz, r.e., '09, runs the works of the American Steel Foundries. This is one of the largest steel foundries and keeping about 1,000 men busy is quite some job.

M. E. Capouch, min.e., '23, is employed by the Illinois Central in the Chicago offices.

R. E. Fagerburg, min.e., '23, is with the C. W. and F. Coal Company of Chicago as mine inspector.

R. N. Ferguson, min.e., '23, is mining engineer with the Pacific Metals Corporation, stationed at one of their Gold Dredging Fields on the west coast of Columbia, South America.

R. R. Lacy, min.e., '23 is an assistant superintendent for the Brewerton Coal Company at Springfield, Illinois.

F. W. Richards, m.e., '91, visited the campus recently. He is a Sales Engineer for the General Electric Company, particularly interested in mine equipment. He has a son, Ralph R., in school who is a '26 e.e.

Departmental Notes

(Continued from Page 40)

The evening ended with a plentiful supply of cider and doughnuts for everyone.

Department News

During the past summer Professor J. K. Tuthill has been with the Illinois Central Railroad completing the rating of locomotives. His work this summer was a continuation of the work started a year ago of rating various types of locomotives. The locomotives are operated under any condition for the ruling grade of each division of the entire system.

Some of the results obtained from the work of the previous year were not correct due to the incomplete road profiles. To correct these errors a party with the Dynamometer Car, which is owned jointly by the Illinois Central and the University, made tests on all the grades that were giving trouble. In some cases the train crew was responsible for the trouble while in other cases the locomotive ratings were not correct.

Most of Professor Tuthill's work was done on divisions west of Chicago. Magnet Hill near Mattoon was used as a basis for calculations last year.

The new laboratory for testing electric railway machinery is nearly completed. The motors and the new equipment, including a Type P C 5, General Electric controller, have arrived. This laboratory will be the very latest word in railway equipment and about the only one of its kind in the country.

Professor King took his class in railway signaling to Tolona, October 20, to inspect the interlocking plant at the intersection of the Illinois Central and Wabash Railroads. The plant is of the mechanical type.

It is planned to have the class visit the electric plant at the Big Four and Illinois Central intersection at Champaign later in the semester.

A series of drop tests on rail joints has recently been completed. The large drop hammer near the University Power Plant was used for the first time since 1918.

The tests were made on welded rail joints used in street railway construction. Manufacturing concerns and street railways throughout the country sent rail joints here. After the tests, the broken joints and results were sent to the convention of the American Electric Railway Engineering Association at Atlantic City.

TRY THIS ONE SOMETIME

Lady: Which end shall I get off?

Conductor: It's all the same to me, lady; both ends stop.

Future Metallurgy of Zinc and Copper Sulphides

(Coninued from Page 22)

other local conditions. A plant consisting of Wedge furnaces, acid-recovery SO_2 equipment, Dorr classifiers, agitators, and thickeners, and with clarifying-filters, and the necessary electro-precipitating plant, would cost from $1,800 to $2,500 per ton of concentrate treated in 24 hours. The cost for treatment per ton of concentrate would vary between $5 and $7. Copper extraction would vary from 90 to 95 percent or more, depending on the degree of roasting, time of treatment and the percentage of copper in the concentrate. There is reason to believe that, within the next few years hydro-metallurgical methods, with electrolytic deposition, will play an important part in extracting marketable copper or zinc direct from the concentrate on the spot. Smelting methods will be gradually replaced to a large extent by the more economical wet methods. Copper, zinc, gold, and silver-bearing concentrates are nearly all amenable to the wet methods after roasting. In many cases the marketing of concentrate costs in the aggregate from $10 to $50 per ton. This includes freight , sampling, smelter charges and deductions, electrolytic refining and selling. Under such conditions the leaching of copper or zinc offers great possibilities in those districts where hydro-electric power costing less than 1 cent per kilowatt-hour is available.

ONE BETTER

He: I think I'll have this car equipped with Steer-Straights something to keep it in the center of the road without any attention on my part.

She: Wouldn't it be a lot better to use the brake?

WHAT DO YOU THINK?

Prof. (in government class): What is a silent majority?

Stude: *Er.*—I guess it's two men when there's one woman present.

WHAT HE THOUGHT SHE THOUGHT

"My, isn't he wonderful. I simply can't drag my eyes away from him, especially his tie."

WHAT SHE THOUGHT HE THOUGHT

"The cute thing, and what a lovely silk sweater."

WHAT EVERYBODY ELSE THOUGHT

"The simp with the pimply necktie has fallen for the dumbell with the stringy blouse."

The International Air Races

(Continued from Page 25)

school children to see them. Driven only by the power of twisted rubber bands, the models went out of sight of the people in the grandstands on many occasions. Mr. Edward Lange of Chicago won the 24 inch bronze trophy and a handsome cash prize. Mr. Robert Jaros '27 and Mr. Bertram Pond '25, of the University of Illinois took second and third places respectively in this novel meet. Mr. Lange made his model go 262.4 seconds in order to receive the honors. It is here interesting to note that all seven of the Mulvihill prizes were won by members of the Illinois Model Aero Club whose members hold all the world's records for these scientific rubber driven models. The Illinois Model Aero Club is a Chicago organization sponsored by the Aero Club of Illinois.

The world's largest plane, the Barling Bomber, dropped in at St. Louis for several days. The pilot maneuvered the big ship around the field with apparent ease which was surprising for its 40,000 pounds of total weight. A perfect landing was made; and directly following the Barling, a very small Sperry Messenger 'plane landed which quite resembled a flea beside the leviathan of the air. Lieut. Harris, the Barling's pilot, received orders to "taxi his ship" to another portion of the field. The blast from the six Liberty Motors of the Barling upset the Messenger 'plane and stood it on its nose, fortunately doing little damage. The body of the Barling is of the proportions of a Pullman car inside. The tail alone is nearly as large as a DeHavilland-Four main wings.. Its 10 wheels are each about 5 feet in diameter.

Not only was the largest aeroplane in the world present at the races, but the largest dirigible balloon in the world also appeared over St. Louis about 3 o'clock in the morning. The crew, 42 in all, got up at the usual hour and had their breakfast in the air over St. Louis, and then they guided the ship out to the field where there was a landing crew with a windlass. The big silver hulk, 680 feet long, was reeled down to earth by means of a rope which had been lowered from a hatch under the nose of the balloon. The big ship, which was formerly the ZR-1, is now known as the Cruiser U. S. S. Shenandoah. It was re-fueled, and the food supply was replenished; then with the addition of Rear Admiral Moffett to the staff, the ship cast off after an hour's stay, and headed for Chicago and "points East."

Air transportation so far has given the world the speediest means of transportation for any weight up to 14 tons. Fast speeds for great loads and faster speeds for smaller loads are a reality in the air. A few of the achievements of the past are: 103,000 pounds total weight of the ZR-1 in the air; 243 miles per hour over a three leg course 30 miles long in a Curtiss Navy Racer; across the United States in the Fokker Monoplane; 35,000 feet up in a LePere Biplane; and across the Atlantic Ocean in the NC-4.

What does the future hold?

The Plym Scholarship

(Continued from Page 27)

awarded. If the winner finds it impossible to accept the conditions at the proper time the author of the design awarded First Mention is recommended. The committee, however, reserves the right of making no award if in their judgement the design or quality of drawings submitted in any competition justifies such action.

Unless unforseen conditions arise which warrant modification of the plan, the winner of the fellowship must sail for Europe not latter than October first, must remain abroad and pursue the study of architecture, following a plan approved by the committee, for a full term of one year. He may not accept remunerative employment during the term of the fellowship.

Holders of the Plym Fellowship, at their option, may also be registered in the Graduate School as candidates for the academic degree of Master of Science in Architecture. A minimum of one full calender year's work is required for the degree; eleven months shall be spent in Europe and the last month in residence at the University of Illinois. Of the eleven months abroad, at least eight months must be spent in some recognized atelier or school in Paris, or in the American Academy in Rome. The month in residence at the University of Illinois shall be used to complete the thesis, the material for which was collected abroad.

CHECK!

A girl may be a Phi Bete and class president but her pals back home never think she's much of a success until she comes home with a diamond.

MILITARY SCIENCE 99X

"An when you get that done," bawled the supply-sergeant to his student understudy, "charge Corporal Hardguy with a bayonet."

"W-w-well," stammered the other, trembling, "if you say so, orders is orders, but you might just as well issue me a wooden cross right now."

The Carpenter Bridge

(Continued from Page 19)

steel was placed and wired. Figure 10 shows the floor ready for pouring. Note the veritable carpet of steel. Again the cars of concrete were run out and this time were discharged directly onto the form boards. Workmen spread the concrete uniformly to the required depth with shovels, at the same time spading vigorously around the steel to insure good bond. The end farthest from the mixer was poured first, and as the work progressed the track was pulled up and the surface of the concrete was floated down to the required crown. This procedure was followed until the entire span was completed.

After all the spans were completed, the posts and the base of the bridge rails were poured. There was only a 3 inch margin between the outside edge of the bridge floor and the base of the rail, so special care had to be exercised in aligning and bracing the forms for the base. The timber posts supporting the center track came in nicely here, for long braces were nailed to these and the entire weight of the tracks then kept the forms at the other end of the braces from springing out of place. These braces are the planks on edge, seen on the right in Figure 3, just above the floor. This figure also shows a section of the rail and two posts after pouring.

At the completion of my summer's work, all that remained to be done to the bridge was the placing of a 4 inch concrete wearing course over the bridge slab, the laying of the brick in the handrails, and the pouring of the top coping of the rails above the brick. The only part of this work that seemed to present any difficulties at all was the finishing of the concrete wearing course. Original plans called for the pavement to be placed over the entire 20 foot width of the roadway. Inasmuch as the rail bases were already in place and projected 12 inches above the floor slab, it would have been impossible to place 4 inch outside forms to properly guide a strike board and finishing belt over the concrete pavement. So it was finally decided to build the wearing course 18 feet wide and fill the outside foot on each side with crushed rock or gravel. This simplified matters considerably and at the same time made provision for the expansion of the wearing course with respect to the bridge super-structure. 2 inch by 4 inch forms were placed 18 feet apart and blocked against the bridge rail base with short pieces of 2 inch by 4 inch timber. Figure 5, taken after a section of the pavement had been finished, shows the forms still in place. The center track, previously mentioned, was partly removed from the south span and the concrete was hauled from the end of the track in two-wheeled carts to the point where it was deposited on the bridge slab. After being spread and leveled, it was struck off with a 3 inch by 12 inch strike board, having a 1 1-2 inch parabolic crown in 18 feet. The pavement was then floated, rolled, finished with a canvas belt, and tested with a ten-foot straight edge. One-half inch expansion joints were placed at the ends of each span. The procedure in each span was identical; the track being removed as the work progressed toward the north end of the bridge. The pavement was completely finished in two and one-half days.

The construction of the brick rails and the concrete coping above the brick will not be taken up in this article, inasmuch as they were not completed until several weeks after I had left my summer work. There is nothing involved in their construction that would be of very particular interest or value to you. Figure 4 is a view taken before the completion of the last span, and before any work had been done upon the rails. This view will give you a basis upon which to build a conception of the final appearance of the structure.

Limitations of space have necessarily eliminated many of the details of construction required to give you a complete understanding of the work done. Consequently, this article has been rather profusely illustrated in the hope that the pictures will aid you where minute detail is lacking, for it is a much recognized fact that pictures convey more definite impressions to the embryo engineer than pages of reading matter. The scenes were all taken with this idea in mind and it lies with you whether or not they have fulfilled their purpose.

DRIP

Woman (hiring plumber): Are you a Union man?

Plumber: Gawd, no! I'm Hawvard.

—*Jester.*

ASK DAD, HE KNOWS

"Pa, what does Veni, Vidi, Vici mean?"

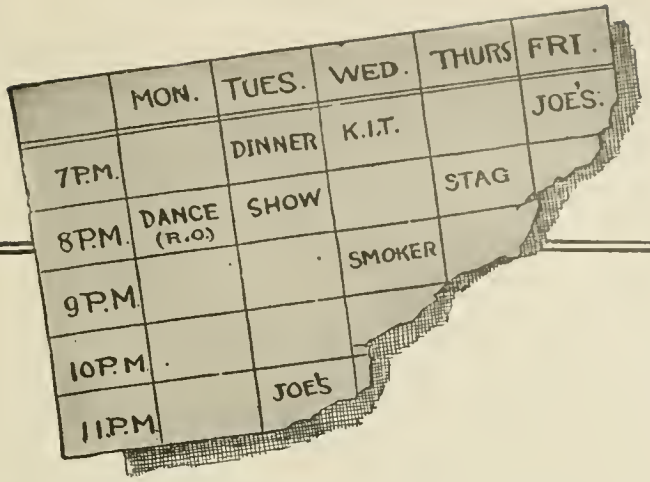
"Oh, it's just one of those college yells."

PAGE SOLOMON

Citizen (thunderously): What are you doing over there?

Neighbor: Beating up my wife.

Citizen (excitedly): May I come over and see how it's done?"



Does your P. M. schedule read like this?

If your burning ambition is to excel as an all-around society man, you couldn't have planned your evenings better. Such persistence will win out over the indolence of the rank and file, for as the poet says,

"The heights by great men reached and kept
Were not attained by sudden flight,
But they while their companions slept
Were toiling upward in the night."

But if you intend to make your mark in engineering or business, don't expect that supremacy on the waxed floor will help when you start hunting a job.

Not that you need swing to the other extreme as a "grind" or a hermit. Let's concede it is all right to minor in sociabilities—but certainly it is only common sense to major in the math and sciences and English that will mean bread and butter to you later on.

Remember this—the harder you work right now in getting a grip on fundamentals, the easier things will come to you when you must solve still bigger problems. And if you take it easy now—well, look out for the law of compensation.

It's up to you. While you've got the chance, seize it, dig in, plug hard. It will pay—in cold cash.

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Two years ago this advertisement appeared in the Western Electric college paper series. It received so much friendly comment from your faculty and alumni, including some graduates who have since entered our business, that we now reprint it —as a suggestion in this busy month of schedules.

Engineering Experiment Station

(Continued from Page 13)

General Electric Company, the Allis-Chalmers Company, the Copper and Brass Research Association, and the Western Electric Company. Progress reports of this investigation have been published in Bulletins, Numbers 124 and 136.

An investigation of the Viscosity and Electrical Conductivity of Glass has been carried on in co-operation with the National Research Council through the Corning Glass Works Fellowship. The results of this investigation are nearly ready for publication.

Investigations of the Friction Losses and Power Requirements in the proposed ventilating system for the New York and New Jersey Vehicular Tunnel, to be constructed under the Hudson River, have been carried on in co-operation with the U. S. Bureau of Mines, acting for the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission. The results of this investigation have been submitted to the co-operating parties, and are ready for publication as a bulletin of the Engineering Experiment Station.

In addition to the above, tentative programs for additional co-operative investigations have been approved and will be started at an early date.

The research activities of the regular Station staff and the teaching staff have had a very stimulating influence upon the faculty and the student body. No single agency has done more than the Engineering Experiment Station to establish the reputation of the College of Engineering. Through the Engineering Experiment Station, the University of Illinois is favorably known wherever engineering is practiced, and the officers of the Station have received many testimonials of the value of its publications.

College Notes

(Continued from Page 33)

phere of the college, both in and out of the class room, should be favorable to the development of this culture."

The technical courses have their cultural value, so long as they do not restrict the mind to too narrow an interest. Economics, history, literature and languages are among the subjects usually recommended as cultural. The true value of these are as complements to the technical courses, and they are successful if the student's interests are so aroused that his broadening will continue after graduation.

Tests of Welded Rail Joints

(Continued from Page 11)

Sulphur, 030 per cent; Phosphorus, .005 per cent; Carbon by combustion, .077 per cent.

The welding flux showed the following analysis: Sodium Carbonate, 84.10 per cent; Silica, .03 per cent; Iron and Alumina, .03 per cent; Calcium Carbonate, .06 per cent; Magnesium Carbonate, .11 per cent; Sodium Sulphate, Trace; Sodium Chloride, .54 per cent; Combine water, 15.10 per cent.

These twelve joints were made April 10th and 11th of this year. The average atmospheric temperature was 64 degrees F. and the average time required per seam was forty-two minutes. One filler rod and 1-4 ounce of flux was required per seam. One-third of a carbon electrode was consumed per seam.

What light the compilation and the analysis of the data on the various tests, will throw on the problem confronting the committee, still remains to be seen. Certain it is, that they will be a revelation. It is to be hoped that a better and stronger rail joint will be evolved as a result of this newly acquired knowledge. Thus a problem of vital personal interest to every urban American is well on the road to a satisfactory solution.

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A Modern Broadcasting Station

(Continued from Page 24)

This station has set up some records of which it can be justly proud. Chief among them is a record for continuous operation of 12 hours and 28 minutes; at the end of that time the set was still functioning perfectly, but the announcer ran short of program and was forced to bring the schedule to a close. Among the more distant places the station has been reported from are: Hawaiian Islands, Chili, Alaska and by numerous ships at sea. Improvements have been made during the summer which should keep this station among the best of the country during the coming winter season.

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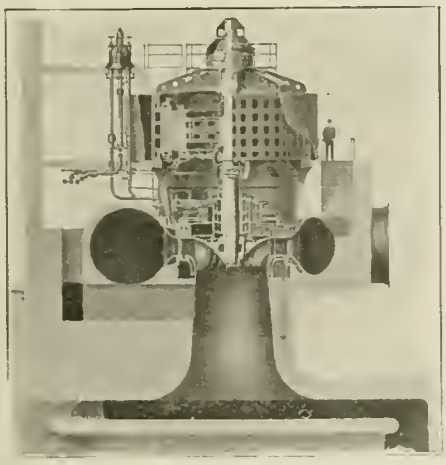

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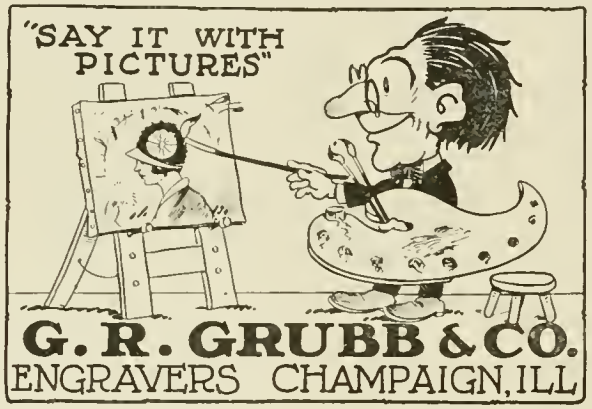

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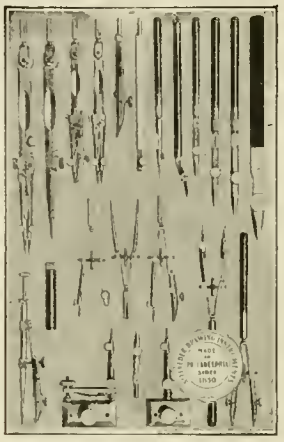

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January

1924

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North Entrance to the St. Gothard Tunnel

THE TECHNOGRAPH

Published Quarterly by the Students of the College of Engineering—University of Illinois

VOL. XXXVI JANUARY, 1924 NUMBER II

Developments in Railway Electrification

MORGAN BROOKS
Professor of Electrical Engineering

Regenerative braking is the key to freedom in railway location in mountainous districts, according to the opinion expressed by Professor Brooks, who, in this article, tells of the progress of railway electrification in Europe, and describes the recent St. Gothard electrification in Switzerland. He points out how tunnel dangers have been removed in this country and abroad, and recalls the collateral advantages of electrification.

Two reasons are commonly assigned for the slow progress that railway electrification is making. The electrical engineer is apt to attribute it solely to the difficulty in raising the capital required to make the change while the civil engineer is confident that he could make such a capital expenditure more productive if applied to reduction of grades or other right-of-way improvements. The railway master mechanic is apt to side with the civil engineer's viewpoint, since as a rule he does not appreciate the far-reaching advantages of electrification. Elimination of the dangers of tunnel operation with coal burning locomotives was the impelling cause of several early instances of electrification in the United States. A terrible train wreck with great loss of life due to obscured signals in the Fourth Avenue tunnel of the New York Central's entrance into New York was the immediate cause of their terminal electrification, while the occasional asphyxiation of members of train crews in the St. Clair River Tunnel of the Grand Trunk Railway caused another early change to electricity. The first electrification in this country was that of the Baltimore tunnel of the Baltimore & Ohio system, and another early example is the Hoosac tunnel in Massachusetts, over four miles in length. The first important instance not inspired by the dangers of steam operation was the electrification of the portion of the New York, New Haven and Hartford Railroad from Harlem, New York to Bridgeport, Connecticut since extended to New Haven, Connecticut.

A notable European electrification is that of the main line of the Swiss Federal Railways recently completed from the Italian border through the St. Gothard tunnel to Zurich, a distance of 175 miles, and to be extended 60 miles in 1924 to Basle on the French frontier. This is the principal route for passengers and freight from France and Germany to Italy and carries immense traffic. The abundance of water power in Switzerland and the high price of coal conspired to favor this project. From the passengers' point of view not only is breathing in the many tunnels comfortable but there is no smoke obstruction in viewing the fine scenery along the line. The picture (Figure 1) is presented to give a faint idea of the engineering difficulties of this mountain route. To diminish the length of the main St. Gothard tunnel it was necessary to elevate the line abruptly, and this was done by means of two adjacent tunnels forming a figure eight, each tunnel consisting of a nearly complete circular curve on a steep grade within the mountain side, each gaining about 100 feet in elevation in curve length of about one mile. Three portions of track visible in the picture are then connected by these helical tunnels, and thus the invisible portion of the line exceeds what is seen in the picture. A little church in the valley, high above the train when first passed, reappears twice surprisingly below the train level, to the mental confusion of the passengers not familiar with this engineering marvel.

The frontispiece shows an electric train emerg-

ing from the north portal of the main tunnel. The motors are of single-phase commutator type, which offer no means for regenerative braking. The double trolley wire discernible at the tunnel entrance is merely the doubling of the single-phase line to ensure reliability of service. Indeed the substantial quality of the construction throughout is in evidence everywhere, and makes for reliability of service quite equal to that of previous steam operation. While under electric traction there has been a slight increase in speed of trains, no great speed can be considered, since the road is almost entirely made up of curves, tunnels and steep grades. The main St. Gothard tunnel, 15 kilometers long, is only one third of the total length of tunnels of the route of about 300 kilometers. The surprising gain in possible traffic on the line since electrification is due to the absence of trains hauling locomotive coal and of the return of empty cars, to the quicker acceleration especially marked in the case of grades, to the continuous full-power tractive effort up the longest hills, and to the possibility of more dense operation with safety since the signals cannot be obscured by smoke of locomotives. A minor gain results from the avoidance of stops for water.

Développement de la ligne, près de Giornico, vu d'en haut
DEVELOPMENT OF THE LINE NEAR GIORNICO, VIEWED FROM ABOVE

The Ritom hydro-electric generating station shown in Figure 2 is one of the principal power-houses of the system. The head of water is 2,500 feet and the penstocks supply four turbines each driving a 9,000 kw. single-phase generator at 16 cycles and at 15,000 volts stepped up to 60,000 volts. There is another similar power-house at Amsteg but with less head of water, and the small hydro-electric station formerly used to drive the tunnel ventilating fans has its power turned into the system, since it is no longer needed for ventilation.

This Swiss electrification is proving so eminently successful and reliable that the complete electrification of all the railways of that mountain republic is assured as soon as financial conditions warrant the change. By the St. Gothard electrification alone, one seventh of the coal burned by the Federal Railways under steam operation has been saved as shown by the 1922 reports when the electrified portion of the line was but 225 kilometers. Nevertheless the gain in traffic without the necessity of constructing additional trackage and the greater safety are considered quite as important as the coal saving.

It is somewhat singular that in Switzerland there are three principal state railway routes operating under different non-interchangeable systems all of alternating current: this St. Gothard route with single phase motors, the Simplon tunnel electrified from its completion in 1906 by three-phase induction motors, and the Loetschberg route, also electrified from the start, with repulsion motors. The frequencies used on these routes are not alike, so that any unification in Switzerland would entail considerable expenditures. Italy also has ample water power, especially in the north, and electrification plans have been completed for all railways as far south as Pisa, and for main line stretches to Rome and Naples. This work, interrupted by the war has not yet been resumed, but with improvement in the financial situation, early resumption may be expected. In the extreme northwest of Italy many miles of electrified railway are in operation, also under different systems.

In Spain, where much water power is awaiting development, little electrification has been accomplished, although electric lines, similar to our interurban lines, are operated from water powers of the Pyrenees. France has electrified some of the railways entering Paris, and many miles in the Pyrenees district, and in connection with the Mt. Cenic tunnel route. The Scandinavian peninsula has made considerable progress in electrification due doubtless to the availability of water power, but in other European countries little progress can be seen. Railway electrification plans have been prepared in considerable detail for the railways of Czechoslovakia.

In our country the longest railway electrification is that of the Chicago, Milwaukee and St.

Paul route to the Pacific, a 450 miles section in Montana, and one of half that length in Idaho and Washington. Here the principle of regenerative braking has been tried out to the highest degree yet attained, and a return of forty per cent of the energy expended in dragging a freight train up a long grade is obtained from the same train in descending. This figures out at fifteen per cent regained for the entire electrified mileage including much level country.

The principle of regenerative braking reveals some rather surprising possibilities in railway engineering. If it be assumed that coasting is just possible on a down grade of half of one per cent, then the return from a grade of one per cent, should approach half, as a theoretical limit, and a grade of two per cent, three-fourths of the energy of ascent. The return of power increases with steepness of grade, thus making the steep grades less objectionable than might be imagined. Compare a ten-mile two per cent grade with a forty-mile half-of-one per cent grade, each lifting a train 1,056 feet of vertical rise. The work done on the forty-mile track exceeds that on the ten-mile track by approximately the energy required to run thirty miles on a level, therefore the power theoretically required to cover the two distances in the same time would be decidedly less for the steeper grade. Since there would be a considerable regeneration possible from the steeper and shorter line and no regeneration from the longer line there would be decided advantage under electric traction in the employment of relatively steep grades to overcome necessary elevations. In developing a new route across a mountain pass, the engineer with the electric traction viewpoint might then adopt a much shorter location with steeper grades than are acceptable for steam operation, with great saving in construction costs coupled with a marked reduction in operating expense. The possible necessity of running trains in sections upon steep grades is not prohibitory as an offset against such advantages.

It is even conceivable that a mountain pass might be crossed at a relatively high altitude, avoiding the long tunnel often reluctantly approved under non-regenerative conditions.

When proper allowance is made for the unavoidable energy required for the horizontal component of traction the percentage of true regeneration of the vertical lift increases to an impressive figure. With electric motors of 95 per cent efficiency the return of the excess of energy above that required for level running might exceed 80 per cent on a curveless track.

The magnetic track brake, easily available with direct current electrification, would give any desired retardation even on a sharp descent. Unlike the wheel brake there is no limit to its effectiveness except the strength of its attachment to the cars and the rigidity of the rails. To act smoothly yet with maximum effect, magnetic brakes must be on every car as well as on the locomotive. As an emergency means of stopping to avoid accidents this type of brake is unrivalled and would complete the engineer's control of his train.

The steady flow of power applied continuously to all drivers by electric motors reduces the racking stresses upon a track and the slipping of wheels caused by the spasmodic push and pull of the reciprocating steam engine. With steam engines the torque at starting, if a connecting rod is on dead center, is limited to the effort of a single piston, while with electric motors all are able to furnish

Usine generatrice de Ritom
POWER PLANT AT RITOM

simultaneously double the ordinary running torque. Because of these conditions and of the further fact that electric motors can furnish continuously for long grades maximum drawbar pull undiminished by loss of boiler pressure, so annoying with steam engines, electric locomotives can haul nearly twice as heavy a freight drag up a long incline as is pos-

(Continued on Page 106)

River Regulation: The Mississippi

Seth B. Morris, c.e., '24

The practice of river hydraulics today depends more on experience and less on scientific theory than almost any other branch of engineering. A literature is needed which shall embody the results of scientific investigation and the writer regrets that he must follow "the customary method of nearly all authors on river and harbor hydraulics, in avoiding the kinetics of these problems and making no attempt at even a crude computation of the forces at work." However, the subject of this paper is an important one and well merits discussion. The practice of river regulation is limited almost entirely in the territory between Cairo and the Gulf, to army engineers, and this fact has led to scant interest in the subject among civil engineers. Perhaps, then, the introduction to the subject which this article professes to be will justify it's publication.

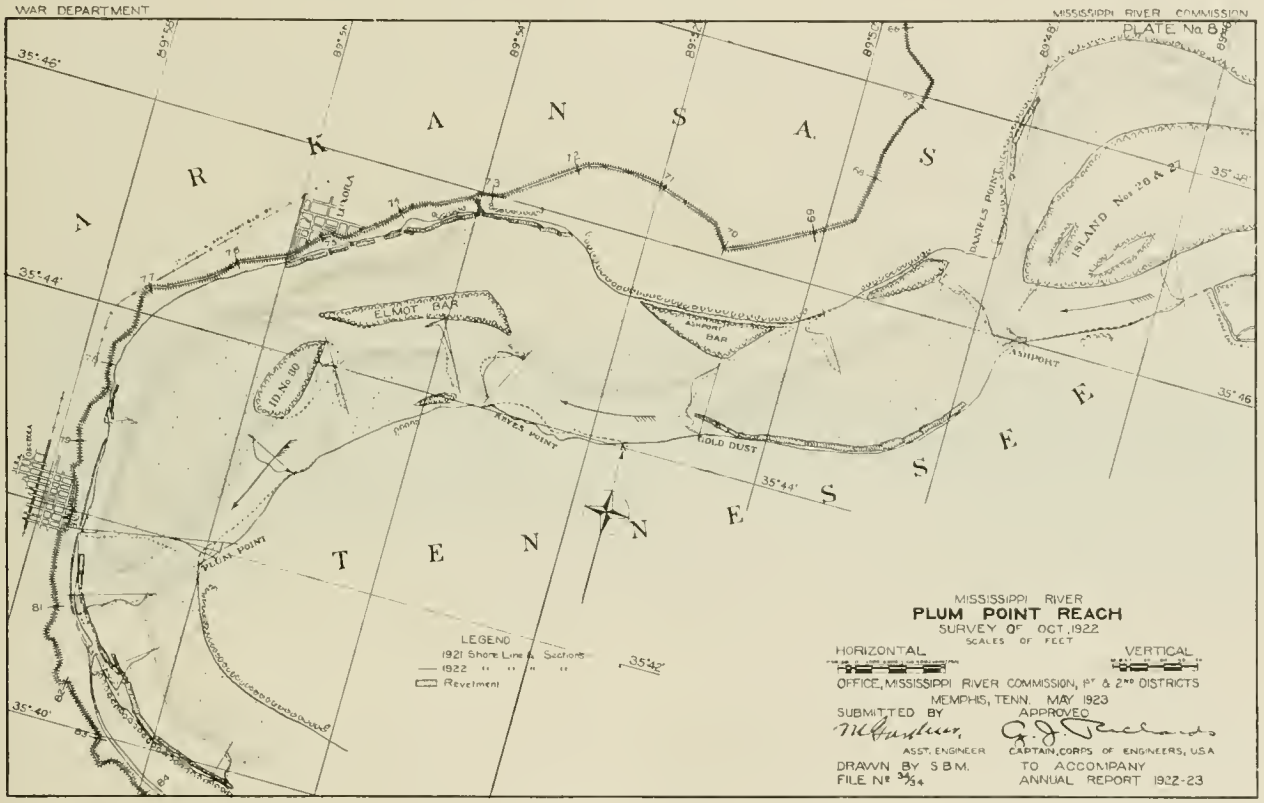
The First and Second Mississippi River Commission Districts, the setting for the most of the writer's experience in this work, extend from Cairo to the mouth of the White River. The Ohio and Upper Mississippi Rivers have here combined to make a great stream, frequently a mile wide and in places over a hundred feet deep. The problems peculiar to the Passes at the mouth, however, are not met in this portion of the river. There are two railroad crossings, one at Memphis, where there are two bridges and one at Helena, Ark., where there is a ferry. On this portion of the river there is, as yet, no serious contemplation of power development. The work of the Department is directed chiefly toward two ends: one, to assist navigation, and the other, to enhance the value of property by protection against erosion and overflow.

To accomplish these ends some very able hydraulic engineers advocate a straight, deep, permanent channel, contending that the forces of the river itself could be directed toward the formation of such a channel. Other engineers advocate a series of reversed curves, and even attempt to develop formulas for the radii of these curves. Previous to 1889 an attempt was made by the Commission to determine the course of the river. This, the famous Plum Point Reach experiment is a landmark in the history of the work. A dam and several dikes were installed to prevent the use of one possible channel and much fascine revetment and bank paving were done to prevent the erosion of the chosen channel. With high disdain for the wishes of mere man the Mississippi immediately swept dikes and dam away, leaving the revetment work buried in the sand. The accompanying map of a portion of the reach, showing the shape of the river in 1922, should be compared to maps in the Report of the Chief of Engineers, U. S. A., for 1889, or in the Proceedings of the American Society of Civil Engineers for August, 1923 (page 1234). Mr. John R. Freeman says that "the report of the Commission in 1889 indicates more or less of a change of base, —since that time, instead of putting the bank where it ought to be,—apparently the Commission concluded that the cost compelled the abandonment of the plan and acceptance of the banks presented by nature, and that most of the works constructed in the future would have to be limited to protecting by revetment the parts of the banks in immediate danger of erosion and caving, which parts are found along concave shores and along city fronts, selecting from hundreds of miles of caving banks the few worst places." A brief history of the work may be found in a paper by the Chief of Engineers, Major-General Beach, in the August Proceedings of the American Society of Civil Engineers (page 1134).

The work of the Commission, as it is now carried out, may be divided into three main divisions; dredging, revetment, and levee construction. Dredging is strictly for navigation purposes. The Commission tries, by means of hydraulic dredge boats, to maintain a channel at least nine feet deep and 250 feet wide throughout. During very low water, such as that of 1922, there are "crossings" which may have a natural depth of only five or six feet. At such times boats of deep draught like the towboats of the Mississippi and Warrior Rivers Barge Line, which operates a commercial barge service between New Orleans and St. Louis, are considerably handicapped. Dredging is also necessary in Memphis Harbor where Mud Island is building downstream and threatens, in time, to cut Memphis entirely off from the river. The dredges are all of the hydraulic type and are mostly self propelling. The general layout of a typical dredge is that of the B. M. Harrod shown on plate IV of Van Ornum's "The Regulation of Rivers."

Revetment is bank protection against erosion. One who is not familiar with the river can scarcely realize the extent of it's meandering in it's alluvial valley. In the map of Plum Point Reach, Island No. Thirty shows a thousand feet of caving in one

year, or rather in one period of high water. It is the present practice to select, from those points where heavy caving endangers levees or towns, as many places as funds will permit and to line the banks at these places with a material capable of resisting the force of the current. Revetment is placed during low water in most cases, and consists of two distinct operations. The first operation, known as subaqueous work, is the sinking of a mattress previously built on the job, and the second, or upper bank work, is the grading and paving of the bank above water level. Fascine mattresses, the



usual subaqueous revetment, are made on the water surface of small willow trees laid parallel and bound together with wire rope. Work begins at the upstream end of the mat, where it is attached to two mooring barges, and progresses down stream, the mat being built continuously on the ways of the mat barge, which moves out from under it as the work goes on. When the mat is completed the mat barge is removed and the mat sunk by loading it with stone thrown from a barge which moves up over it from the lower end, the portion first built being sunk last. The picture shows a mat under construction. In the foreground is the mooring barge, and to the right is the eroded bank which will be protected. Upper bank work consists of grading the bank with hydraulic graders (washing down with a water jet), and paving it with riprap or concrete, the latter being more common at present. It has no unusual features except that all the machinery is floating. The entire process is described in detail in Van Ornum's "The Regulation of Rivers" together with methods in use elsewhere. Several photos of the work are given in the Report of the Chief of Engineers, U. S. Army, for 1889 (part IV), which differs from present practice chiefly in the riprap upper bank work. A plan is being worked on at present which would replace the fascine mattresses with concrete slabs. It's advantages would be economy and, it is hoped, speed and the ability to work in strong currents. Some of these have been sunk in the relatively quiet waters of the Ohio at Cario, with promising results.

Levee construction along the river is progressive. The Commission establishes a standard grade line to which it, with the assistance of the levee districts, undertakes to build the levees. When this grade is nearly reached throughout the river it is customary for a new grade to be established and all levees raised to this new standard. This policy is discussed and defended by Mr. A. L. Dabney in the Proceedings of the American Society Civil Engineers for August, 1923, (pages 1149-1154). The present standard levee has an eight foot crown, a three to one river side slope, and a three to one land side slope together with a forty foot banquette on the land side beginning eight feet from the

crown having a four to one slope. There are borrow pit and grubbing specifications designed to disfigure the ground as little as possible and to eliminate any material which, by decay or otherwise, might cause failure of the levee. Construction is either contracted out to private firms or done by the Government forces themselves. In the first case it is usually by mule teams, assisted perhaps by a tractor for loading the wagons. In case however, that the Government does it's own work a special dragline apparatus is used. One of these has a six-yard bucket, a haul capacity of over seven hundred feet, and moves in the neighborhood of four thousand yards of loose earth per day. This machine cost the Government $135,000, erected on the job. It builds the levee in two sections, the banquette first, and then the upper part of the levee from a position on the banquette. The machine is accompanied by a small steam shovel, tractors, stump pullers, mules, etc.

Construction of a Fascine Mattress on the Mississippi River

Such is the present practice of the War Department in this portion of it's domain. One who has seen the Father of Waters in flood stage learns to have a real respect for it and may even feel that it is impossible to further control it. On the other hand one who has not seen it may wonder why it is not replaced by a straight concrete flume. The officers in charge feel that they are doing their work in the most economical way. Severe criticism of their methods has come from every source. The writer has been told confidentially that the system of levees parallel to the river is all wrong, and that the correct way is to build them perpendicular to the river. He has also learned that the construction of dredges like the B. M. Harrod is necessary in order to keep money in circulation, although a much better job could be done by sinking barges in strategic positions in the river. Mr. John R. Freeman feels that our scientific knowledge of the subject can be greatly increased by laboratory experiment. His paper in the Proceedings of the American Society of Civil Engineers for August, 1923 demands serious consideration, although perhaps it does not fully establish the necessity for a laboratory such as he describes. The chief drawback to such a laboratory is voiced by Col. Dent in the Proceedings for November, namely that "empirical laws cannot be safely extended beyond the limits of the experiments from which they were derived." He questions whether deposition of sediment can be investigated in a model having a much distorted vertical scale, such as would be necessary in a laboratory.

In conclusion let us bear in mind the position of the Chief of Engineers: "It is to be expected that . . . various alternative plans will be urged for achieving the results desired. . . All the proposals have been investigated and reported on time and again. However, with the growth of the art of engineering, plans which were not practical in the past may become feasible in the future, and the Engineer Corps will maintain an open mind in the investigation of any reasonable means for river control that are presented by responsible organizations or able engineers."

Some Economic Aspects of Superpower

K. K. Kraeskoff '25 and B. J. Lucell, '24

The foundation upholding the glories of ancient Greek civilization was not the minds of her philosophers nor the victories of her warriors. It was the aching muscles of her helots, —slaves—who toiled in misery that the fair haired Hellenes might have the leisure to build the nation whose influence we still feel though centuries have passed, and we are half a world away. For each Greek family there were five helots but for each man, woman and child in this country there is the equivalent of thirty such servants. They work night and day, require neither food nor clothes, and feel nothing of the misery of servile life. And our civilization, too, rests on our power slaves.

Dr. Good, of the University of Chicago, has given on several occasions a lecture called "Coal and Civilization." He gives some interesting figures which show far better than words the point that I am trying to bring out.

The following is a portion of one of his charts: The countries are listed in order of greatness and the table shows their coal production for 1912.

United States	700 million tons
Great Britain	290 million tons
Germany	250 million tons

Coal is the greatest source of power today so it is easily deduced that the countries making the best use of power are the foremost.

The United States is not only the greatest producer and consumer of coal but it also has by far the largest coal resources. We are often reminded of this by those who "point with pride." They tell us that even though we are approaching a billion tons as our annual requirements the reserves are so great that less than half of one per cent has been touched. That all sounds reassuring but we must realize that the fuel we now use is the best in the country. What we have to consider is not "how long, in an absolute sense, our coal will last, but when shall we have to make changes in our industrial structure because the conveniently located and high grade coals, upon which concentrations of industry and specialized uses are dependent, are beginning to run short[1]." That time is not far off and it's advent deserves the fullest consideration.

Waste in Coal Industry

Our methods of coal production are, if possible, even more wasteful than those of the early lumbermen in the Michigan white pine forests. According to the report of the Federal Trade Commission in 1917 for every ton of coal brought to the surface another ton is placed beyond recovery by wasteful methods. This has resulted in the permanent loss of millions of tons of coal that might have been saved. Too many mines operating under competitive conditions is one cause of waste. Competition forces down the mine mouth prices so only that coal which is easy to mine will be produced and the coal that is hard to get is wasted in the process. Coal mining is not generally recognized as a public utility. We have even attempted to force competition upon the operators which aided, of course, in the demoralization of this basic industry.

But if the methods of production are bad, those of utilization are incomparably worse. Most of the coal used in this country is consumed for the energy content alone, with no attempt made to recover the thousand or more by-products it contains. There seems to be no limit to the number of things that chemical science can produce from the "waste" part of coal. "There is a wide range of these products, affording essentials in agriculture, pharmacy, painting paving, water proofing, wood preservation and an ever widening circle of other requisites touching every aspect of human life. There can be no full utilization of coal which fails to take these matters into account.[1]"

In most cases only a very small part of even the energy content is actually used. The rest is lost in the ash pit, up the stack and in the conversion of heat energy into mechanical energy. "The story of coal is a story of waste—waste of natural resource, waste of human endeavor, waste of capital, waste of transportation, and waste of energy.[1]"

This waste is partly due to unwarranted spirit of optimism on the part of large industries, to unwise legislation and to a lack of intelligent co-operation. Improper utilization may be laid at the door of our mania for volume production which tends to narrow lines. We have not turned readily to multiple or by-product production. Industry lacks the competitive spur. "The loss in wasteful consumption of raw coal was not felt by any one unit since wastefulness was universal and the cost—was shifted in it's entirety to the shoulders of the consuming public.[1]"

The stimulus for improvement must come from the outside. The public must become interested be-

cause they are the ones who will be benefited by improvement.

What Can Be Done to Further Conservation

Coke. Coke made by the solvay process, means the production of a good clean fuel and the recovery of the by-products. Will this solve our problem?

Coke will undoubtedly aid in the elimination of waste but the industry has a long way to go toward perfection. In 1921 almost a half of the coke used was produced by the wasteful "bee-hive" method. But the most serious difficulty lies in the fact that the coal from the parts of the country where our resources are greatest will not coke except by a prohibitory expensive process.[2] It has come to a great importance in the iron industry but it still leaves us to face the necessity of providing an adequate scheme for the economical utilization of our fuel resources.

Oil. Any plan for substitution of petroleum must be summarily dismissed. Although at present it is very important, our oil reserve has been so depleted that it will be exhausted within the next two decades. For my purpose, it's greatest value is as an object lesson of what not to do with the remainder of our great natural wealth.

Water Power. When we first turn our attention to hydroelectric power there seems to be a rift in our cloudy reflections. However, anyone with a pessimistic turn of mind, in fact any but incurable optimists can soon find some more difficulties. Development of our water power resources is hindered by:

1. Adverse legislation.
2. Public sentiment.
3. Heavy initial cost of plant.
4. Power transmission, and other engineering problems.

Perhaps the significance of (1) is often over estimated but we can justly attribute much of our poorly developed water power to lack of constructive effort on the part of the government.

There is less capital needed and therefore less risk involved in building a steam generating plant than in a hydro-electric plant of the same capacity (3). As utility commissions are prone to insist that the lower operating cost be reflected in lower rates there is no incentive for capital to run this added risk. As a result of this, only the best water power sites have been developed and the poorer ones are not bothered with as they cannot compete with steam on the present basis. Thus it appears that we are in need of constructive legislation if we are to use this heritage to it's fullest.

Public sentiment (2) is a factor well worthy of consideration. Many power sites are located in public parks and places of scenic beauty. It seems wrong to people with highly sensitive aesthetic tastes that Niagara and the rest should be harnessed and put to servile work. Engineers often find their projects blocked by such sentiment. "Thus a river that flows through the town has it's course unsullied by commercialism. Instead a trolley park with a merry-go-around, loop-the-loops and the like occupy the power site.[1]" This sort of thing will hold back water power improvements until the public can realize the enormity of it's loss.

Withall, there were, on file with the Federal Power commission in January 1921, requests for projects totaling over 13,000,000 horse power.[3] Improvement is inevitable, but it will probably come slowly.

The United States is a young nation and her industries are still expanding. Steinmetz has calculated that the maximum that can be extracted from water power is just about equal to the total energy we now obtain from coal.[4] With the demand for power increasing and our oil supply failing, even if it were possible to develop water power to the fullest we would still find ourselves dependent upon our coal. Like the proverbial bad penny our problem is still with us.

Most of our water power sources are located in the part of the country where coal is lacking (see accompanying table). As industry grows in these sections hydro-electric power will be developed and they will not depend on coal which has to be hauled many miles.

Thus water power, the most promising of all our possible substitutes, can do little more than relieve a good part of the increase in power demand.

Advantages of Superpower

There is a popular notion that super-power means hydro power. This has caused a great deal of confusion in the public mind. A super-power system is a network of moderately high voltage lines supplied by economical generating stations located at strategic points. It may or may not include water power generators, according to the character of the section in which it is located. "It is not a plan to compete with existing generating stations but to co-ordinate them in the most economical manner.[5]"

Given the premise that public utilities are industries of decreasing cost, any one who knows the elementary principles of economics can easily deduce that, within reasonable limits, the larger the generating plants that we could build, the better off we would be. This is just what makes up the greatest advantage of super-power systems.

The interconnection and co-ordination allows the plants to be located at the most advantageous places. These must be developed to the point of greatest efficiency while the poorer generators are gradually dropped out or made into transformer station. Large plants have the means of by-product saving and other devices for fuel economy. This should result in an improvement in service and reduction in rates, and if it can be continued to the place where all individual industries will buy power through the central station rather than generate their own we will be well on our way toward a better utilization of our fuel.

The world war brought about a realization of the enormity of our losses in fuel and made imperative

TABLE SHOWING DISTRIBUTION OF WATER POWER IN SECTIONS LACKING IN COAL[1]

	Potential Water Power % of the Total in U.S.	Unmined Coal % of the Total in U.S.
New England States		
Main, Vermont, New Hampshire, Massachusetts, Rhode Island Conneticut	3	None
South Atlantic States		
Delaware Maryland Virginia, South Carolina, Georgia, Florida	6	1
Southwestern States		
Arizona, New Mexico, Oklahoma, Arkansas, Louisana	6	4
Pacific States		
California, Oregon, Washington	43	2
All others	42	93

some relief in the denser industrial districts. In June 1920 Congress passed an appropriation bill of $125 000 to be expended by the U. S. Geological Survey in making a survey of the super-power possibilities in the section between Boston and Washington. It covered the territory from the 39th to the 44th parallels and about 150 miles inland from the coast. The most interesting of the findings of the Boston to Washington super-power survey were those which showed the enormous savings that could be effected by the super-power system. W. S. Murray, chairman of the survey committee, in a progress report of February 24, 1921, estimates that super-power would have saved 20,000,00 tons of coal in the Boston-Washington district alone, during the year of 1920.

The plans for super-power development in this territory include hydro-electric power as well as steam. The report estimated that in 1930 the zone would use 48 billion kilowatt hours and that approximately 20 per cent of this would come from water power.

Here in the middle west there is a super-power system that has been slowly growing throughout the last decade. The Insull holding companies control most of the utilities around Chicago. Unified control has made it easy for them to secure the co-operation of the others in extending the net work. "Taking Illinois and Wisconsin together, with the exception of three of four breaks, (the longest only 27 miles) there is 36,000 square miles of territory operating under the same frequency of alternating current, supplied by a series of power stations stretching from the extreme southern part of Illinois to—almost the northern part of Wisconsin.[3]

To the utilities in this chain, power output has become more and more important each year as compared with domestic use. In the Public Service Company of Northern Illinois, for example, power customers have increased from none in 1910 to more than half the total number present customers.

I think the possibilities of electric power are nowhere better illustrated than at the Clearing industrial district, Clearing, Ill. The factories here range from steel foundries to glass works and the only power used is central current from the Public Service Co. In the district bulletin last year Mr. Haskell said, "I believe we are pioneers in a most promising field. It is inevitable that all industry will eventually follow us."

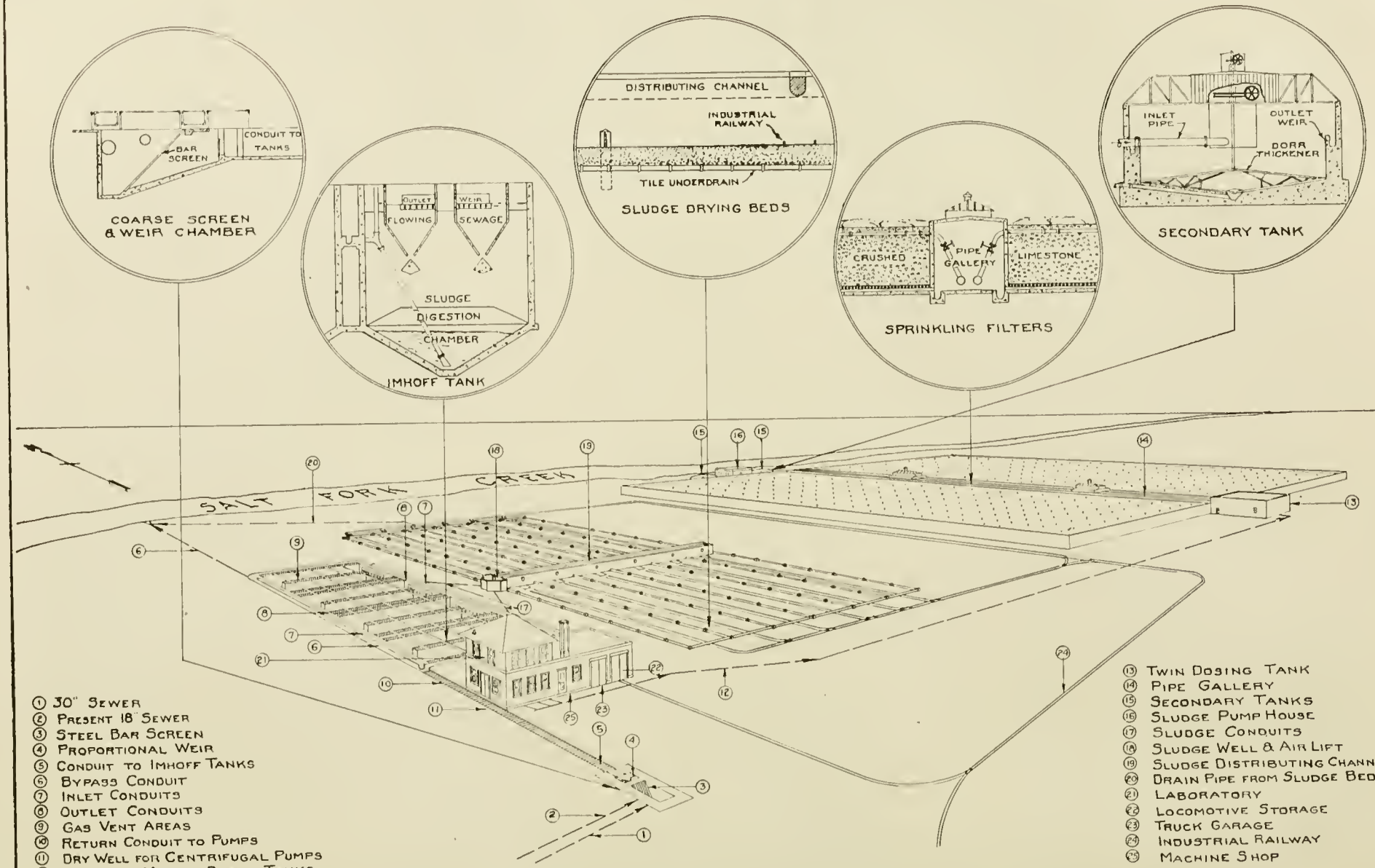
Conclusions

There was a time in English history in which each family was a self sufficing unit—each produced the things it needed by crude and laborious means. This was known as the handicraft era. Since the industrial revolution the home has given over most of it's labors to large, specialized plants. But even today nearly every family has it's own little furnace where it painfully extracts from raw coal the energy it needs. And worse, because they use many times more coal, our industries, from the largest to the smallest shops, each has it's own plant which withdraws a small per cent of the power and utterly wastes the rest of the coal.

Here is an industry still in the handicraft stage. All but a very small proportion of our coal is used in this wasteful manner. I have mentioned two main causes for it's backwardness. 1. The spirit of unwarranted optimism and 2. the lack of competitive spur.

If let entirely alone, the situation would undoubtedly improve in the course of time. Exhaustion of coal and railroad congestion would eventually raise coal prices to the point where at least the smaller shops would be forced to turn to central stations for power. Then the utilities would gradually group themselves into some sort of chain which

(Continued on Page 90)



Perspective of Completed Plant

Drawn by A L. Tholin

The Urbana-Champaign Sewage Treatment Plant

A. L. Tholin, m. and s.e., '24

Half a million dollars is being spent by the people of Champaign and Urbana for the collection and treatment of domestic and industrial sewage. Approximately $300,000 will be spent for the treatment plant which is being constructed and the remainder will be spent for the intercepting sewer, now being laid through the Twin Cities. This article is intended to discuss only the former.

Why should the people spend this amount of money, and how is such an expenditure justified? In answer, one can only say that it is a part of the battle of the present civilization against the ravages of water borne diseases. Locally, it means the relief of the overloaded condition of the present sewers, the intercepting of all sewage now flowing into the Boneyard, and the removal of a sufficient amount of the objectional matter in all the sewage before it enters the Salt Fork.

Process. The process consists essentially of five parts as follows: coarse screen, Imhoff tanks, sludge drying beds, sprinkling filters and secondary tanks. The secondary tanks are not included in the present contract of the Urbana-Champaign plant; they were part of the original design, but due to lack of funds it was deemed inadvisable to build them at the present time. If, after a few years of operation they are found to be necessary, they may then be added without great cost.

The perspective view, accompanying this article, shows the completed sewage treatment plant with enlarged sections of the five parts which are important in the process. The enlarged parts will be taken up in order and explained in detail for they form the principal steps in the process of sewage treatment. The reader, by frequent reference to the drawing will be able to follow the entire process, and gain a clear understanding of this type of treatment.

The sewage will enter the plant through the present 18 in. sewer and the new 30 in. intercepting sewer. After flowing through the coarse screen, which will remove any large floating matter, it will pass over the proportional weir and, then, through a covered, concrete conduit to the Imhoff tanks, which may be expected to remove from sixty to seventy per cent of the suspended solids.

These solids will remain in the lower compartment of the tanks and, after being digested for a period of several months by bacterial action, will be withdrawn and dried on the sludge drying beds. After being dried, the sludge, which then resembles a black humus will be hauled away on the industrial railway and used as a fertilizer.

The liquid from the Imhoff tanks will return, through a conduit, to the wet well under the pumping station, from where it will be raised by centrifugal pumps to the dosing tanks, attached to the sprinkling filters. From there it will be discharged intermittently and sprayed over the filter stone through a multitude of circular spray nozzles. By this method, the sewage will be aerated and while it trickles down through the filter, it will be further oxidized by the aerobic, or air-loving bacteria, which dwell in abundance on the surface of the stones. The amount of suspended and dissolved solids in the effluent from the filters is usually about the same as in the influent but is of a different nature. The compounds are more stable and are not liable to become septic after being discharged into the creek.

There are, however, certain periods when the growth on the stones sloughs off and it is during these periods when secondary tanks are most necessary. Such periods usually occur in the spring and fall of each year, due, probably to the change in temperature. To take care of this, under the present program, the sewage will be conducted through two small, artificial lagoons before flowing into the creek.

The accompanying table gives the principal data of the design of the plant. It is estimated that the plant will be running at full capacity in 1938. The plant is so constructed that additions may be easily made at that time. The intercepting sewer, however, will be sufficient for the estimated flows until 1960.

Coarse Screen. The screen will be constructed of 3-8 in. by 3 1-2 in. steel bars 15 ft. 6 in. long, and spaced at two inch centers so as to form a screen, six feet wide. It will be inclined at an angle of forty-five degrees to the horizontal and will be placed with its upper edge resting on a small platform, spanning the screen chamber. From this platform, the screen may be cleaned with a long handled rake.

Just beyond the screen and in the same chamber, will be placed the proportional weir, so constructed that the quantity of sewage is directly proportional to the head on the crest. A small pipe will connect the chamber, in back of the weir, with a float tube, below the southwest corner of the laboratory.

By means of a recording device, attached to the float within this tube, there will be kept a constant record of the amount of sewage entering the plant.

Imhoff Tank. This type of tank was first developed by Dr. Karl Imhoff, in 1906, and installed by him in the Emscher District of Germany. The essential features are the two story construction and the narrow slot, above the triangular beam, which allows the solids to settle through but diverts the rising gases to the gas vent areas.

In order to gain a clear conception of the type of tank to be used here, let us imagine that we take a wooden box, about as wide as it is deep and three times as long. Then, knock out the bottom and

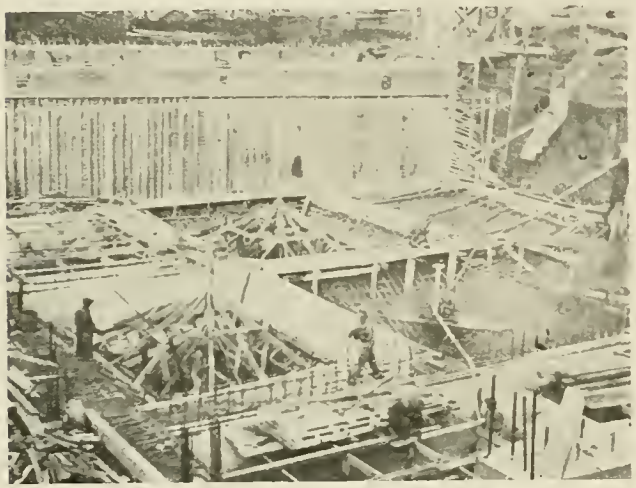


Fig. 2. Construction of Hopper Bottoms

replace it with three hollow pyramids, turned upside down and placed side by side so as to form a three hopper bottom about a third as deep as the box itself. Figure 2 shows some of these hopper bottoms during construction. The wall, shown in background of the picture is the partially completed wall of one of the tanks.

Then, place within the box five partitions, spaced equally along its length, with their bottom edges arched up, over the hopper bottom, and their upper edges deeply notched, to receive the settling channels. Figure 3 shows two of these partitions, or cross walls, during construction. Because of their great depth, the tanks were constructed in three lifts or stages. Figure 3 was taken after the second lift had been built.

Returning to our model, let us place in the notches which were built in the partitions, two troughs, as long as the box itself, and having a cross section as shown in the top of the enlarged drawing. These troughs form the channels, through which the sewage will flow and, as can be seen in the drawing, they will be open at the bottom to permit the settling of the solids into the lower chamber. Then place a small triangular beam below each slot, and, except for a few details, your model is complete.

Imagine this box to be constructed of reinforced concrete with an inside length of 76 ft., a width of 28 ft. 4 in., and a depth of thirty-two feet. You will then have a representation of one of the four units to be used in this plant. The section shown in the perspective is a section across one of them at the center of one of the hopper bottoms.

The sewage will enter the settling channels through an annular orifice, controlled by a regulator valve, similar in principle, to the ordinary needle valve. As shown by the accompanying table, it will flow very slowly through these channels, allowing the suspended solids ample time to settle. The outlet is over an adjustable steel plate weir, into a collecting conduit leading back to the wet well.

The four tanks are arranged in parallel, so that the total flow of sewage will feed eight channels. Inlet and outlet conduits will be provided at both ends of the tanks so that the sewage may be made to flow in either direction through them. By revers-

ESSENTIAL DATA OF DESIGN

	1922		1938	
	Dry Season	Wet Season	Dry Season	Wet Season
Population of District	35,000.00	35,000.00	50,000.00	50,000.00
Population connected to Sewers	31,500.00	31,500.00	45,000.00	45,000.00
Average flow of Sewage (M.G.D.)	1 37	3.37	1.96	4.82
Imhoff Tanks				
Time of Retention (Hrs.)	4.3	1.75	3.0	1.23
Velocity of Flow (Ft. Sec.)	.005	.012	.007	.017
Sludge Storage per Capita (Cu. Ft.)	3.3	3 3	2.3	2.3
Sludge Drying Beds				
Area per Capita (Sq. Ft.)	0.95	0.95	0.67	0.67
Dosing Tanks				
Time of filling (Minutes)	13.7	5.5	9 5	3.9
Time of Dosing (Minutes)	2.4	2.4	2.4	2.4
Sprinkling Filters				
Rate per Acre (M.G.D.)	0.86	2.10	1 23	3.00
Average Depth (Ft.)	10.0	10.0	10.0	10.0
Secondary Tanks				
Time of Retention (Hrs.)	2.0	0.81	1.4	0.57

ing the flow, occasionally, the deposition of sludge in the hopper bottoms will be more uniform.

The sludge will be removed from the bottom of the tanks through 8 in. cast iron pipes, leading up out of each hopper bottom and emerging from the side of the tank at an elevation, approximately 5 ft. 7 in. below the surface of the sewage. This difference of hydrostatic pressure is sufficient to force the sludge up the pipes and into the sludge channels. The flow will be controlled by means of shear gates at the outer ends of these pipes. A branch from each pipe will extend upward, through the gas vent, to the top of the tank so as to admit a hose for flushing in case the pipe should become clogged.

Each sludge channel will serve two tanks and will conduct the sludge to the sludge well, where it will be raised by an air lift to the level of the sludge drying beds.

The tanks are being constructed with relatively thin walls, heavily reinforced. The side walls taper from a thickness of 12 in. at the top to 16 in. at the bottom. The end walls are 16 in. thick and the cross walls are 12 in. thick, throughout. Continuous T-beams will extend across the four tanks above each of the cross walls. In addition to their structural value as a tie between the walls, they will also be wide enough to act as walks.

The settling channels, will be 12 ft. 9 in. deep, 9 ft. wide and as long as the tank itself, with their bottoms converging to a slot, 8 1-2 in. wide at the bottom. Between each pair of channels and between each channel and the outside walls will be the gas vent areas, 3 ft. wide. The outside vents will extend throughout the entire length of the tank but the central vent in each tank will be cut off, 6 ft. from each end of the tank and the settling channels joined so as to allow the sewage to flow out over a single weir. This is shown in the perspective drawing. Both the side walls and the bottoms of these channels will be 4 in. thick, reinforced with 3 in. mesh, 4 lb. W. & M. gage wire fabric.

Sludge Drying Beds. Adjacent to the Imhoff Tanks, will be the sludge drying beds which will be a group of twelve sand beds, separated from each other by concrete planks, and underdrained with four inch vitrified tile, laid with open joints. The filtering material will vary from 12 to 24 in. in depth and will be graded from a fine sand at the surface to a coarse gravel at the bottom.

Sprinkling Filters. There will be two dosing tanks, having a capacity of approximately 13,000 gallons each. Each tank will discharge through a 20 in. siphon onto one half the filter area. By means of an air-lock feed, the sewage will be filling one tank, while the other is discharging and vice versa. The tanks will be constructed with sloping bottoms so that the greater portion of the sewage will discharge under a high head. Since the spray limit at the nozzles is directly proportional to the head on the siphon, this means that the greater portion of the dose will be sprayed near the outer limits and the distribution per unit of area will be more uniform than could be obtained with a flat bottom tank.

These tanks, which are also of reinforced concrete, will be placed with their upper edges 8 ft. 11 in. above the filter wall and will be supported, in part, by it. The remainder of their support will be given by a 9 in. wall, extending down to the footings

Fig. 3. Construction View of Imhoff Tank

in the ground and forming, with the tanks, a rectangular structure, 22 ft. high, 32 ft. 9 in. long and 35 ft. 11 in. wide.

The sprinkling filters will be built in two units with a covered pipe gallery between them. Each unit will be 222 ft. long and 157 ft. wide, fed by 207 nozzles, placed in rows 12 ft. 2 in. apart with the nozzles spaced at 14 ft. centers, in each row. Taylor, circular spray nozzles with a 1 in. orifice will be used. The main delivery pipes in the pipe gallery will vary in size from 20 in. at the siphons to 8 in. at the extreme lower end. Extending outward, at right angles to these mains will be the 8 in. and 6 in. C. I. P. laterals with 2 1-2 in. riser pipes feeding the individual nozzles. These laterals will be laid in and suported by the filter stone, 1 ft. below the surface.

The average depth of the filter stone will be 10 ft. varying from 9 ft. 6 in. at the outer edges to 10 ft. 6 in. adjacent to the pipe gallery. The stone used will be crushed limestone, ranging in size from 1 in. to 2 in.

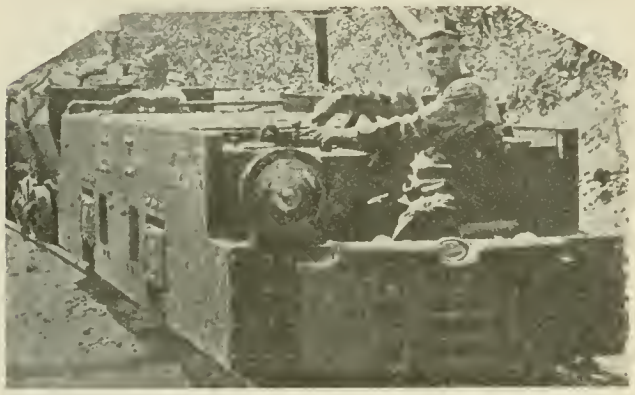
The underdraingage used in the sprinkling filters is the ridge-and-valley type of construction, overlaid with vitrified clay brick. The floor was first con-

(Continued on Page 101)

Power Data for Illinois Coal-Mining

A. J. Hoskin
Professor of Mining Engineering

Fifty-two counties in Illinois possess producing coal mines. More than two-thirds of the 1100 mines are operated upon small scales with cheap equipments and are known as 'wagon' mines because their outputs are hauled away in highway vehicles for domestic consumption within small areas. Such mines are operated about 135 days in the year with



Electric Mine Locomotive. Modern Application of Power to Heavy Underground Haulage

an average working-day production of 177 tons.

In contrast with such little mines are the 352 so-called 'shipping' mines, with railroad facilities. These are worked about 125 days only per year but produce an average of 1395 tons per working-day. The production of the average shipping mine is thus nearly eight times that of the average wagon mine.

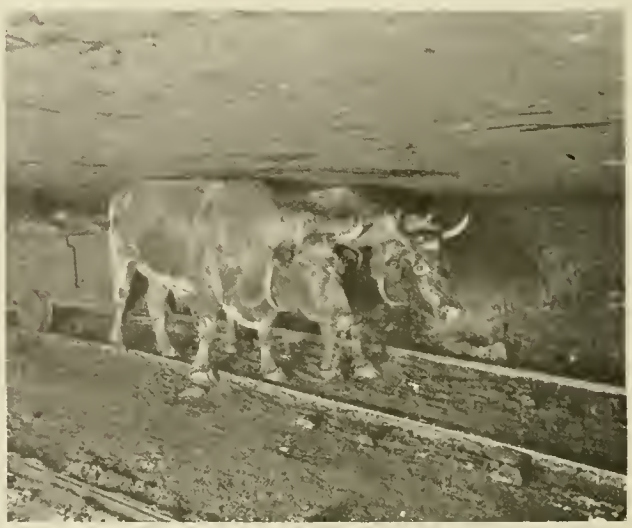
Many of the shipping mines are of as low tonnage as the average wagon mine; but, on the other hand, Illinois claims some of the largest coal mines in the world, if mines be gaged by their daily accomplishments. One mine in the state can easily produce and hoist 6000 tons in one 8-hour working day. The greatest output for a year by any single Illinois mine was at the rate of 5637 tons per working day. Another mine was a close competitor with a daily average of 5416 tons. There are 35 mines with daily averages for a year of more than 3000 tons.

Of the gross output of all the mines that have railroad service, 31 per cent is absorbed by railroad companies while exactly twice this amount is shipped to distant markets. As a rough average it is not economical to ship Illinois coal more than 500 miles because of the heavy freight rate.

Comparatively little power is consumed in a wagon mine. Sometimes in drift mines the only use for any power is to drive a fan but this is a small item that is handled by the simplest unit—often second-hand—of a boiler and an engine. In the small mines that are worked through shafts (often shallow) steam operates the cheap hoisting engines in addition to the fans. But in nearly all of these wagon mines the coal is mined by hand and is transported underground either manually (as in tramming) or by mules. A small amount of steam may be required to pump water. However, we may say that the wagon mine, taken as a type,—yes and many a small shipping mine—has a power problem that is most simple, the power itself being generated from mined material that is screened or rejected from the gross production and hence is ordinarily considered simply waste.

From such simple proportions the power item in coal mining varies through all stages of scale and complexity to the most recent mining plants at large mines. Steam is used at nearly all mines for hoisting but electricity has replaced it in nearly every other activity about the Illinois coal mines. Compressed air became popular about twenty years ago for driving machines underground where steam could not be used but it, too, has been superceded by electricity.

The majority of the mines of the state are what may be termed mixed-power mines, *i.e.*, they use both steam and electricity for their underground mechanical operations. It is difficult to obtain



Primitive Method of Underground Haulage

figures for the relative consumptions of these two kinds of power at such mines. Few operators of these mines have even rough estimates as to what their various mining departments or activities are costing.

The steam consumed around coal mines is always locally generated. The electricity, however, may be home-made or purchased—sometimes both. The locally-generated electric power is, of course, dependent upon steam generation in a boiler plant which may be simultaneously supplying not only the engines (or turbines) that drive the dynamos but also hoisting engines, air compressors, pumps and various other machines. At such plants the segregation of power costs for the different operations is obviously difficult—in fact, impossible. Power loads for all duties around a coal mine fluctuate abruptly and widely, with the single exception of the power demand by the fans. Flows of steam to hoisting engines and compressors are most erratic and immeasurable by any meters thus far placed upon the market. When all power is home-made its gross cost can be determined easily but there is no way of knowing the efficiency in any use thereof. However, when all power is electricity and that is purchased, there can be no ignorance of its cost figures. At the same time, every operation is through the use of motors whose power consumptions are easily measurable. At such mines accurate data on the respective costs of the several mining activities may be recorded.

"It is an interesting fact that the average daily cost of power is less at mines which use purchased electricity exclusively than at mines which use home-made, or so-called 'generated' electricity." This fact has been disclosed by the scheme which Prof. Hoskin worked out, and in this article he explains why Illinois power companies can buy coal, develop power from it, and sell the power back to the coal mining companies cheaper than they can develop it themselves.

It is convenient in studying coal-mining power data to recognize six divisions of power distribution. These divisions cover cutting (mining), haulage, hoisting, ventilation, pumping and miscellaneous. Recent studies of this problem indicate that no two mines are alike in their consumption nor in costs of power for these six divisions. Mines of about the same capacity prove as unlike in their power distributions as mines of widely differing capacities. In other words, there seems no definite relationship between the demands for power by the several activities of coal mining whereby one may say offhand that any specified mixed-power mine requires a certain amount of power for this or that purpose. Each mixed-power coal mine is truly a problem in itself when it comes to determining its power demands.

To promote investigations along this line with the object of encouraging betterments or economies, the writer has suggested a scheme for computing and pro-rating the power consumptions at mixed-power mines. Space will not be taken to describe this scheme. However, it has received the approval of all coal-mining officials to whom it has been submitted, as it has permitted them, for the first time, to intelligently segregate their power costs to the several branches of their operations. The method was applied to 40 typical Illinois mixed-power mines and the figures thus determined disclosed many interesting facts. The average daily production of these mines is 3027 tons and the average hoisting depth is 402 feet. The power consumed in the mining operations averaged 8.284 cents per ton. The cost was distributed as shown in the table at the bottom of the page. Another grouping covered 50 mines, five of which used electricity exclusively for all power needs. It was found that the consumptions were as follows: Hoisting, 17.2%; Ventilation, 22.2%; Pumping, 5.0%; Mining, 22.1%; Haulage, 23.0%; Miscellaneous, 10.5%; Total, 100.0%.

The most interesting thing about these average results is that they do not hold true for a single mine.

Miscellaneous uses of power include tipple screening, driving of equipment in blacksmith and carpenter shops, illumination and heating. This item remains comparatively close to 11 per cent for many mines but very often other items vary widely.

Shallow mines are often the wetter, so that while their hoisting is lighter, pumping is heavier than in deep mines.

Hoisting varies all the way from 1.4 per cent to 50.8 per cent; ventilation from 2.2 per cent to 61.9

(Continued on Page 102)

Hoisting	1.562 cents	or 18.8 per cent
Ventilation	1.970 cents	or 23.9 per cent
Pumping	0.683 cents	or 8.2 per cent
Cutting	1.889 cents	or 22.8 per cent
Haulage	1.254 cents	or 15.1 per cent
Miscellaneous	0.926 cents	or 11.2 per cent

Engineering Open House

After seven hours of inspection by seventeen hundred visitors, the biennial Open House of the College of Engineering, held December 8th, passed into history; the engineers again went into retirement in their haunts north of Green Street.

What did Open House mean to the visitors? Apparently the impressions of the engineer and the layman were at a wide variance. According to the latter, if the articles published by the local newspapers can be taken as a fair judge, the innumerable displays of the Open House were mystifying, astounding, awe inspiring and in many cases hopelessly beyond comprehension. In some places overall clad individuals, who would hardly appear to classify under the genus of the popularly pictured "campus snake," labored with the cruder materials, while at other points more collegiate appearing persons exhibited intricate devices capable of performing highly technical duties.

To the engineer the analysis of the situation, coupled with some statistics, gave an entirely different meaning to the Open House. It showed, in a comparatively small area, the work of fifteen four-year curriculums in nine branches of engineering science. Practically the whole field of engineering was being demonstrated, on a small scale, in such a way that a comparative study of the various divisions could be made. Engineering from the office work of designing to the shop work of actual production, was spread out for inspection.

It is doubtful if the engineers, themselves, realized what their brother engineers of other lines were accomplishing or capable of doing. In this connection it would not seem out of place to review the Open House briefly by touching on a few of the high spots of the exhibition.

The first arrow pointed the way into the Engineering Hall to the portion where the civils hold sway. The exhibitional part of their numerous south campus excursions, together with some design problems and field instruments were neatly displayed. Above the civils the architects were industriously "doing their stuff" in the preparation of Beaux Arts competition work. In the Ricker Library many interesting and valuable architectural books were on display.

Down out of Engineering Hall and into the next building gave the Physics crowd their chance at the visitors. The quantity and quality of the exhibits there set a high mark for the other departments to strive for. Everything from singing tubes, high vacuum pumps, optometry equipment, to the business of chasing atoms was displayed. By the time the visitors got past the voluble demonstrators and out through the Physics laboratory shop they felt that the rest of the trip would have to be made hurriedly if they were to take in all the sights.

Over along the Boneyard the miners were showing how coal and metal mining and metallurgical processes should be carried on. Back of the Mining lab the intricacies of the ceramic arts were set out for inspection. Everything from brick to fine china was being made, just to show the versatility of the aspiring ceramists. The State Geological Survey and the United States Bureau of Mines threw open their quarters to the visitors, for their first appearance on the Open House program.

Down another long flight of stairs and into the Locomotive Testing laboratory brought the trip into the domain of the railway engineers, still a non-union organization. The foresight of the railway men in providing a picture show, where the weakening marchers could rest in preparation for the other half of the trip, should be commended. The miners completed their exhibits on the second floor of the Transportation Building with pictures and models of mining methods.

The program for the introduction of the incoming freshmen to the field of engineering was shown by the general engineering drawing department. A fine display of drawings made by students in the different courses showed the quality of the student work to be up to that of many commercial offices.

The trail back along the Boneyard led to the Highway and Mechanical Engineering laboratories. In the latter the equipment that has been installed since the last Open House, two years ago, was in operation. This consisted of an Otto Gas Engine, a Terry turbo-generator connected with an Allis Chalmers direct current generator, an Ingersoll Sargent air compressor and a Murray Corliss engine. The University power plant, back of the mechanicals' toys was also receiving callers.

A combined traffic cop, guide and safety-first agent skillfully handled the throng at the Short Line crossing and sent them on to the Foundry. At this point one of the most interesting exhibits of the whole display started to take shape—the two cylinder gas engine that is manufactured by the stu-

(Continued on Page 100)

The Manufacture of Diaspore Into Fire Brick

Blakesley Barron, cer.e., '25

The plant, to which this article refers, is located near Danville, Illinois. It is at present owned by the General Refractories Company; but was formerly one of the American Refractory Company's plants, which company, it might be said, deserves the credit for successfully investigating and using diaspore as a highly refractory clay in the manufacture of fire brick.

At this plant are manufactured three grades of fire brick, namely, the 'American,' 'Arco' and 'Arcofrax, the latter being the highest grade, containing approximately fifty per cent alumina.

The materials used in making these bricks consist of diaspore and clays for the Arcofrax, and hard and soft flints and diasporite for the lesser quality brick. The most refractory clay, however, is the diaspore. Up to a few years ago diaspore was considered a foreign substance, as sandstone, in the flint deposits. It was mined out and used for road beds, railroad ballast and in some cases the mines were abandoned because they could not market the so-called sandy or rough clay. The sudden realization of its value nearly created feuds between several companies, as each attempted to buy up the few deposits that were then known to exist.

Up to the present time diaspore is found only in the state of Missouri. There is a mineral found in considerable quantities in Japan which is very similar. Bauzite, analyzing higher than Missouri diaspore although also usually higher in iron, is plentiful in France. The clay fields of Missouri are located about 120 miles west of St. Louis, along the line of the Rock Island railroad. The clay fields gradually spread out into the flint deposits. There are hundreds of diaspore pits in the state but probably a majority of these pits are too small to be workable or contain iron, alkali or other impurities, rendering them useless for refractory purposes. However, there are two or three hundred deposits containing diaspore that have been located, drilled and are supplying, or could produce, commercial diaspore. In addition to these deposits there are thousands of white flint pits. While the supply might not be said to be inexhaustible, new deposits of sufficient quantity are being found each year that will provide enough for a great many years to come.

Diaspore is readily distinguished in the field by its abrasive effect on steel. It can be easily told by wetting the sample slightly and rubbing the back of a pocket knife over it. If it is a good grade of diaspore it will scratch the steel in the knife, showing a black streak where rubbed. On the other hand flint or burley clays will not do this. This abrasive property of diaspore causes the wearing out of dry pans, liners and other metal parts much faster than the ordinary clays.

The average pit is slightly elliptical, ranging from 100 feet to 150 feet in length. The depth varies from a few feet to 100 feet as a maximum. The average size is probably 120 feet in diameter by 60 feet in depth. The quality of the clay does not vary noticeably as the depth of the pit increases, as some diaspore which was mined at a depth of 60 or 70 feet has analysed 78 per cent alumina.

The usual method of mining is by the stripping and open pit process. This is the general practice with the exception of one mine at Belle, Missouri, which is operated by sinking a shaft and tunneling under the deposit. However, this method was not particularly profitable to the operator. The majority are in close proximity to the railroad, a few being twelve or fifteen miles away. In such cases the best grade of clay, especially the surface boulders which have been washed free from foreign materials, are hauled by truck to the railroad. Little delay is caused in shipping and very rarely does the demand at the plant exceed the output at the mines. It may seem strange that the plant is located so far from the source of raw material, but when placed where it is, the proximity to the market was undoubtedly carefully considered. In this case, as is often true, it was cheaper to ship raw material this distance than the finished product the same number of miles.

The equipment and methods of manufacture at this plant are up to modern standards. The plant is supplied by three railroads, the Big Four, C. and E. I. and Wabash giving sufficient transportation facilities for the handling of all incoming raw materials; and also making possible a routing of shipments to any destination. An elevated track, running back to the crusher pit, expeditates the unloading of clays. Enough space has been provided for clay storage, there being eight large concrete bins inside the factory and a broad expanse of concrete flooring out-of-doors to afford space for the weathering and ageing of clays. The preparation equipment consists of: one dry pan, one dry press of twenty thousand nine inch brick per day capacity,

and three wet pans for tempering the hand moulding clay. The plant has a capacity for hand moulded shapes equivalent to several thousand brick per day. An overhead distribution system for the handling of the tempered clay from the wet pans to the hand moulders is in use. Metal lined drop bottom carts are hauled by an electric motor and cable from the wet pans to above the moulders' tables and dropped where needed.

The driers are supplied almost entirely by an underground waste heat system from the burned off kilns. In cases of an emergency, when the kiln burning is irregular, an auxiliary furnace is used. The smaller shapes and dry press brick are dried in this manner while the larger hand moulded shapes are more slowly dried on the hot floor. This floor is above the drier tunnels; so the pieces laid out to dry get the benefit of the heat radiated from drier tunnels as well as hot air from pipes overhead. Such careful methods are necessary in handling large pieces to prevent cracking and warping, which is caused by too rapid drying.

On the yard are eleven thirty-two foot down draft kilns, coal fired. Temperatures ranging around 2700 degrees Fahrenheit are obtained in these kilns when calcining diaspore. Sufficient space has been provided around the kilns giving plenty of room to pile coal; and the usual neat appearance of the yard presents an entirely different spectacle than the average brick plant.

A storage shed, over four hundred feet long, can hold approximately three million nine inch brick. The outgoing shipments are loaded at the shed, either from the stock on hand, or directly from the kilns. The maximum shipping capacity is ten cars at a time; shipments, however, usually being made at the rate of three or four cars per day.

In the manufacture of diaspore brick one of the great difficulties is to decrease the shrinkage in drying and burning. This is accomplished by calcining from 50 to 75 per cent of the mixture at cone 18 or 20, about 2700 degrees Fahrenheit. Another difficulty experienced is in obtaining a good bond in the dry press brick. The wet pan treatment and ageing before pressing largely overcomes this. It was found that the mould liners are short lived under the abrasive action of diaspore and they had to be tempered to a maximum in their manufacture in order to hold up under the strain.

In burning the hand moulded 'Arcofrax' shapes it has been found that a too sudden rise in temperature caused checking, or too much concentration of heat would produce a slightly different shrinkage or warping of the brick. To cut down these losses the high grade shapes are boxed in the kiln with silica brick. The effect of this boxing assures a good draft with uniform temperature throughout the kiln, thus reducing the shrinkage and giving an equal burn to all sides of the piece. In this type of kiln setting, however, the good draft stimulates a rapid rise in temperature, which is very apt to drive moisture from the brick so fast that they will crack. Slow firing, with the doors left unchoked for 48 hours or more, is often necessary to stop this. In setting the nine inch brick the tight bolt method is in use, giving an even burn to all faces of the brick. This also provides a strong construction necessary to prevent heaving or falling of the brick during the burning.

Diaspore produces a dense heavy brick that will not stand thermal shock. It has a tendency to spall badly, small pieces break off when subjected to a sudden change in temperature. If not properly manufactured diaspore brick have a tendency to fail in the load test at a high heat, however, this can be remedied by producing a dense brick containing a high percentage of thoroughly calcined material. It has been found that the resistance to spalling increases as the alumina content of the ware increases.

The greatest feature of the diaspore brick is its refractoriness. It will stand 3500 degrees before starting to fuse. The lowest commercial grade, the 'American' fuses at 3000 degrees. The density of these brick, however, make them good conductors of heat and when used in oil burning and high heat furnaces the loss of heat by radiation has to be guarded against by careful insulation.

As diaspore is a neutral material it may be substituted for chrome as a neutral agent between silica and magnesia. Diaspore can be used in nearly any type of high heat furnace not subjected to extreme temperature changes, however, under reducing conditions they are apt to fuse at a much lower temperature than in an oxidizing atmosphere.

A demand for such brick seemed to be general as a great many companies found that in them they had what they had long been looking for. They are now being used in boiler settings, oil burning furnaces, lining lead smelters, special high temperature electric furnaces, electric furnace roofs and rotary kilns that are subjected to high temperatures. Several lead companies, a few big power users and dolomite burners have used the diaspore brick successfully. The fact that these companies are satisfied with this type of fire brick has led several well known refractories manufacturers such as LaClede-Christy, Evans Howard, Harbison-Walker, Parker-Russell and A. P. Green, to experiment in the manufacture of diaspore brick and furnace shapes.

The Sandslinger Molding Machine

W. G. Roesch, m.e., '25

This article was selected from the papers required by Pi Tau Sigma of its pledges.—Editor

Whenever an experienced molder wishes to ram a deep parting, or pocket, in a difficult pattern, he throws handfuls of compressed sand into the place; it needs no further ramming. This principle has been applied in a type of molding machine known as the Sandslinger. The machine is not only used in ramming difficult pockets but is used to ram every part of the mold. The size or shape of the pattern which is being used has no effect on the efficiency of the machine as its unusual, yet simple method of ramming eliminates all such limitations.

The underlying idea in the design of almost every type of molding machine is to perform the ramming operation. The reason is that on an average of fifty percent of the labor of molding lies in the ramming. The inventors of the Sandslinger, Messrs. Beardsley and Piper, also designed their machine to perform this operation, but instead of following any precedent in the field of machine design, they based their efforts on the practical experience which they had had, and as a result embodied the slinging principle of ramming in their machine.

The first machine built was made entirely of wood. Since its construction, a great deal of experimental work has been done with the result that the latest types of Sandslingers embody in their design a number of ideas based on experience in the use of the machine. The types now manufactured, which are all evolutions of the first stationary one, are the stationary, tractor, portable, and locomotive.

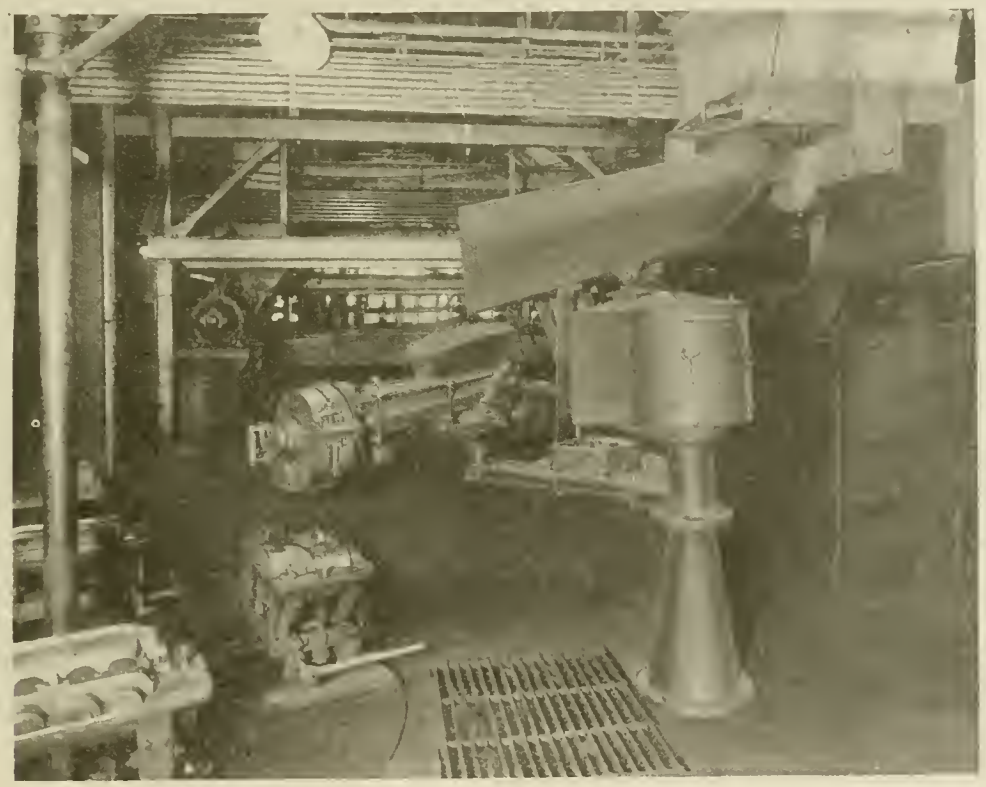


Fig. 1. Stationary Type of Sandslinger

The essential parts of the Sandslinger consist of a suitable mechanism for handling the sand, which will discharge it into an inclined chute leading to the sandthrowing head. This ramming head, or impeller head as it is called, is mounted on a double jointed arm which may be swung into any position over the mold that is being made.

The impeller head is really the heart of the machine. It is the means by which the sand is thrown into the flask. The ramming head may be turned to different positions so that the sand can be thrown into the flask at varying angles from the vertical. The head consists of a cast-iron drum on which is cast a set of brackets. The drum is keyed to the drive shaft of an electric motor. The impeller

blade itself is bolted to the brackets on the drum and is made detachable so that it can be removed when necessary. When in use the sandthrowing head is enclosed in a combination cast-iron and sheet-iron hood. The sand enters the top of the head and is carried around to the bottom by the impeller, which rotates at a high speed, and is ejected violently into the flask. The impeller head not only throws the sand but also compresses it into wads preparatory to throwing it, just as a molder would do.

The impeller speed can be varied from twelve to eighteen hundred revolutions per minute as desired. The variance in speed produces also a variance in the density of the sand rammed in the mold. This is evident from the fact that the greater the speed of the impeller, the greater will be the force with which the sand is thrown into the flask. Therefore if it is desired to ram hard or very dense, the head should be moved faster over that part of the mold. If it is desired to ram soft or less dense, the head is moved slower over that part of the mold.

The tractor and locomotive types have self-motive power. The tractor is mounted on spur wheels which mesh with two racks that extend the length of the floor over which the machine is run. It is by this means that the tractor is prevented from slipping as it works its way into the heaps of sand which are arranged in windrows between the two racks. Where a foundry is of considerable length the tractor goes in one direction one day and back the next, leaving in its wake each time a line of finished molds. This does not mean, of course, that the Sandslinger does any stripping operation. It does not. Its sole function is to perform the ramming operation, but due to its adaptability it can be used in conjunction with strippers with great success and effectiveness.

If sufficient flask and pattern equipment is provided and arrangements made so that the machine can work steadily, it is capable of delivering from seven to ten cubic feet of sand per minute to the flasks, depending of course, upon the speed of the impeller blade. Since the time of ramming a mold, at a given speed and therefore at a given density, depends on the capacity of the flask, production from a Sandslinger is very easily figured providing the percent of efficiency of the transporting facilities is known. The impeller speed which is necessary to obtain the correct density for gray-iron is from 1200 to 1400 revolutions per minute. For steel castings it is 1800 r.p.m.

A very common job which the sandslinger is producing is the molds for automobile engine castings. One tractor type of Sandslinger with fourteen men—five to make molds, eight to do the coring and one man to clamp and build the runner boxes

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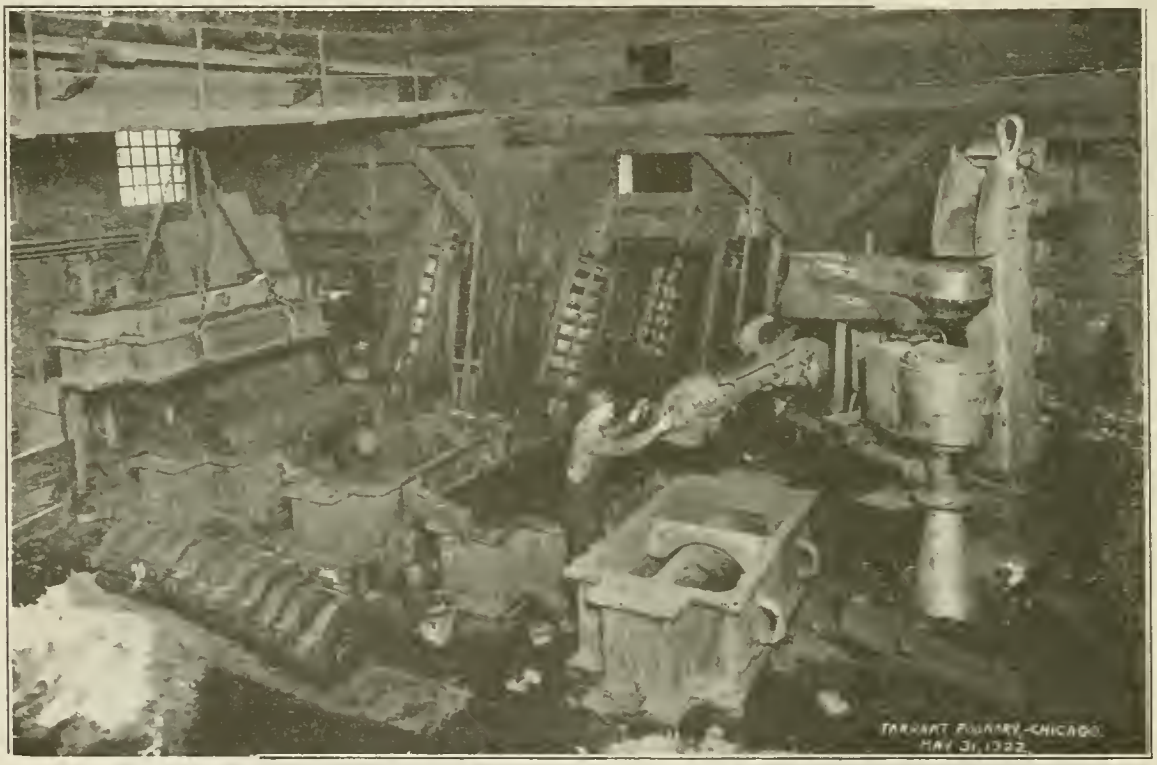


Fig. 2. Portable Type of Sandslinger Molding Large Castings

A New Waterworks for Lewiston, Idaho

L. G. Straub, c.e., '23
Graduate Student

Part I.—Considerations Entering into the Design of the Waterworks

The new waterworks plant which has been planned and is being built for the City of Lewiston, Idaho, has presented unusual structural design features as well as the problems encountered in the design of a complete waterworks.

Lewiston's first waterworks plant, installed in 1891, was privately owned. It consisted of a steam pumping plant taking water from the Clearwater River—a stream passing through the city—and pumping it into mains and the existing low reservoir. The distribution system served only the present business district and residence section in the valley. In 1902 the City of Lewiston purchased the plant and in the following year made a substantial enlargement to the system by additional pumping equipment, the construction of the present reservoir, and the extension of the distribution system to serve the residence district on the higher elevation.

Practically all of the mains laid at this time were machine banded wood pipe. From time to time more mains were laid as needed or funds were available for such extensions. Electrically driven pumps were installed and other additions and changes were made at the pumping station.

The present supply is taken from the Clearwater River through two twenty-four inch intake lines which extend into the main channel of the river. The water flows by gravity into a small settling basin and then to a pump suction well. Chlorine gas for sterilization is applied in the suction well. The water is then pumped to the low and high pressure systems.

On account of the lower power rate during the night, an attempt is made to do all necessary pumping from 9 o'clock P. M. to 7 o'clock A. M. However, the capacity of the reservoirs is not large enough to supply their respective districts for the remaining 14 hours of the day during the summer months, so it is necessary to pump during the day.

Each reservoir has a capacity of approximately 1,000,000 gallons. The lower reservoir is 108 ft. in diameter with a water capacity depth of 14 ft.. It was built with brick walls, but on account of leakage was later lined with concrete. The high reservoir is 109 ft. in diameter and 14 ft. deep, of masonry and concrete construction. The difference in elevation of the two reservoirs is 115 ft.

The distribution system, including lines to reservoirs consists of approximately 31 miles of steel and wood pipe, ranging from two to sixteen inches in diameter. The high system is connected to the low system in three places, so that by opening a gate valve the higher system may be thrown into the down-town or lower system. All wood pipes are now being replaced by cast iron.

Using 6700 as an estimate of the population, which is about 125 more than the U. S. Census report for 1920, the average consumption per capita per day amounts to 275 gallons. This is very high for a city with practically all services metered in comparison with the statistics of other western cities having similar physical and climatic conditions. The superintendent of the water and sewer department estimates that of the total amount of water consumed 36 per cent is for free municipal use, 13 per cent lost by leakage, 35 per cent sold by meters and 16 per cent sold by fixed rate. Direct revenue is obtained on only 51 per cent of the total pumpage.

Records show that the maximum consumption for one day in the past has been approximately 4,000,00 gallons, or 600 gallons per capita. During the period of 24 hours of the maximum daily consumption, the rate of consumption will be at least 50 per cent higher for a few hours.

Based on an increase in population of 6,000 in the next twenty years, or a total population of about 12,500, reservoirs are being built to provide ample storage capacity to furnish the excess maximum rate of consumption over the average rate of pumpage, and also to have a reserve for the excess rate for fire demands and to supply the demand for short power interruptions.

The new low reservoir was designed to have a capacity of 4,000,000 gallons. It will be octagonal in plan to conform with the shape and contour of the site which was purchased by the city. It will be floated directly with the existing low reservoir. This combination will give a storage capacity of 5,000,000 gallons in the low level system.

To the high system a reservoir of 3,600,000 gallons capacity is being added. As the water level in the new high reservoir will be 21 ft. above the water level in the existing high reservoir it was found necessary to place a float valve in the pipe connecting the two reservoirs to keep the water

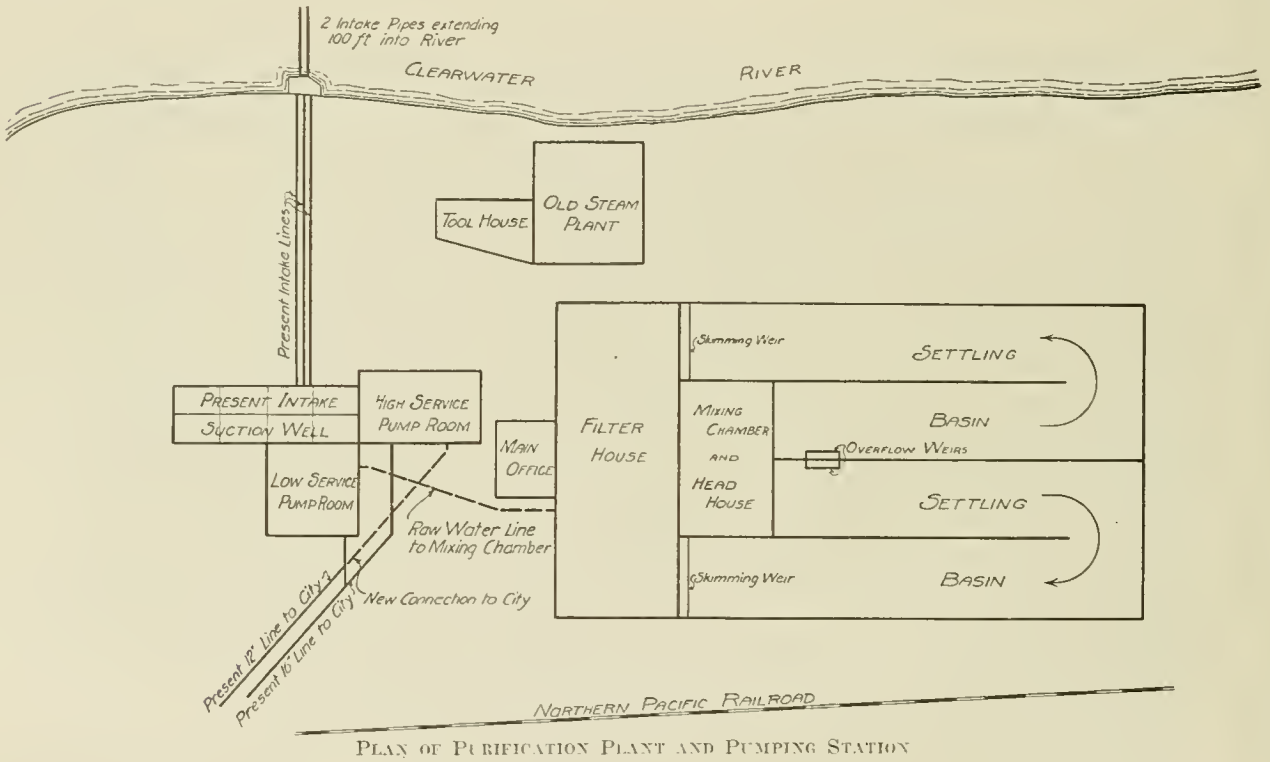
levels adjusted properly and avoid overflow in the existing reservoir.

There were a number of sources of water supply for the City of Lewiston suggested as feasible or possible for a new supply. The three main sources considered may be classified as gravity, wells, and Clearwater River. After a number of surveys and investigations were made, and first cost, cost of upkeep and the quality were jointly considered it was decided to use water from the Clearwater River.

All gravity supplies were found prohibitive because first costs of construction exceeded the bonding limit of the city, and the quality of most of the sources considered would be doubtful without treatment. Pumping costs would have been eliminated, but fixed charges of interest on investment and depreciation charges on a larger plant would more than offset power and labor costs. Condemnation proceedings, local water rights and questions of interstate water rights would have been involved in practically all gravity supply projects.

The possibility of an ample supply from wells or infiltration galleries seemed more or less doubtful with the information at hand. Water from shallow wells is liable to pollution unless wells are carefully located, curbed and protected. The well water is of moderate hardness and much harder than the Clearwater River water. The construction costs are more or less indeterminate as the costs depend upon the location of the wells, the distance from present system with the necessary connecting pipe line, the yield of the well and consequently the number of wells required. Most of the well projects considered were of high first cost. Operation and maintenance costs for a deep well system of pumps is usually high, and where wells are scattered they are more or less unwieldy to operate. Deep well pumps are of comparatively short life, with rapid loss in efficiency on the centrifugal type due to impeller wear, or by slippage in valves in the reciprocating type.

Clearwater River was chosen because it furnished a supply that is ample for all present and possible future growth and needs, and because for a relatively small first cost a filtration plant could be constructed that, at a small additional operation cost, will deliver as wholesome and pure a water for domestic use as any underground supply. The river water is much softer and better for industrial purposes than the average well supply.



Plan of Purification Plant and Pumping Station

The purification plant is of the standard gravity mechanical filter type, consisting of chemical mixing chambers, sedimentation basins, filter basins and storage reservoir for filtered water. River water will flow through the existing intake lines into the basins or pump suction chamber. Low lift motor-driven centrifugal pumps, drawing from this chamber, will discharge the water into the mixing chamber where it will receive a small amount of coagulating chemical, either sulfate of alumina or sulphate of iron. The coagulant combing with

the calcium bicarbonate of the water, produces a chemical reaction and an insoluble white floc or hydrate is formed.

The water then enters the settling basins, where the velocity of flow is reduced to an almost quiescent state and the feathery white floc is precipitated. In the settling action the minute particles of floc gather together into larger particles, which absorb practically all of the suspended matter causing turbidity and color. This settling action will remove from 75 to 80 per cent of the turbidity, and a similar percentage of the bacteria in suspension.

After passing through the settling basins, the water is collected by a skimming weir and passes through a concrete flume to sand filter beds.

The filter basins are of concrete and contain the strainers and manifold pipe collecting system on the bottom. Around and above this collecting system is approximately fifteen inches of washed and graded gravel supporting a bed of uniformly graded sand approximately thirty inches deep. Water enters the filter basin through a series of flumes on top of the sand and passes down through the sand and gravel into the strainer and collecting pipe system, which delivers it to the filtered water reservoir. A small amount of coagulant floc remaining in the water is carried on the filter beds and collects on the top of the sand bed forming a gelatinous mat which furnishes the real filtering medium and action of the filter.

The maximum permissible rate of filtration is approximately two gallons a minute per square foot area of sand bed. The effluent pipe of the filter is equipped with a device which controls the rate of filtration.

After a certain period of run the accumulation of dirt on the filter becomes so heavy that the filter becomes "clogged" and requires a greater head to force the water through at the prescribed rate. The filter then requires washing. The method of washing is the reverse of the filtering action. Influent water from the settling basins is shut off and clear water is forced upward through the strainer system. Water rising through the gravel and sand at a high velocity- about 7 to 8 times the filtering rate—will lift the sand into a semi-suspension and will wash the grains and carry off all dirt. The wash water overflows into flumes leading to the sewer drain pipe. It requires only about 8 to 10 minutes for washing and the unit is ready for filtering action again.

The filters are guaranteed by the manufacturer, to produce a water free from color, turbidity and material in suspension, and to remove at least ninety-seven per cent of the bacteria. Less than three per cent of the filtered water is required for washing. All valves controlling settled water, filtered water, wash water, sewer drains, etc., are hydraulically operated, being operated and controlled from a central operating table, so located that the operator can see the washing and action of the filter when manipulating the valves.

Liquid chlorine is applied to the filtered water to destroy any remaining bacteria and furnish an additional factor of safety.

Water will be drawn from the filtered water reservoirs and distribution systems by the present pumping equipment.

The settling basins were designed as two units in order that one may be cut out for cleaning while the other remains in operation. The filter plant will be divided into four units. All mixing chambers, settling basins, filter basins and the clear water storage reservoir are being constructed of reinforced concrete.

The superstructure consists of the chemical control house or head house, main office and the filter house. The head house will contain the chemical storage rooms, chemical feed machines, wash water tank, and heating plant. The filter building will house the pipe gallery operating valves and tables and operating floor of the filters.

Designs for this plant were made under the direction of Burns & McDonnel, consulting engineers, of Kansas City, Missouri. Construction was begun in October, 1923.

THE NEW BOSS

The new boss we got was a white-collared gink
Who come from a college somewhere.
"Well, here's where the outfit is put on the blink
An' we has our troubles, for fair"—
Yes, that's what we said, an' we swore at our luck
An watched to see how he began
Till after awhile we discovered we'd struck
A boss who's a Regular Man.

He's white an' he's square, but he's right on the job
He knows how the work should be done
For he's done his bit with the laborin' mob
An' savvies the way that things run.
An' whether he learned it in college or out
He handles us all on a plan
That's just an' that's decent, an' proves beyond doubt
Our boss is a Regular Man!

—Berton Braley

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Student Engineering Societies

Engineers everywhere loudly acclaim the advancement in the profession brought about through the medium of the various large engineering societies. The papers, reports, discoveries and discussions of the members of the various societies fill many volumes each year and probably they represent the latest and most authentic works on the development of the various branches of engineering that it is possible to obtain. All of this great work is brought about through the efforts of the members of the societies who take upon themselves the responsibility of preparing papers and reports, which tell of their work or which express their opinion on matters of importance in the engineering fields.

To stimulate the interest of student engineers in the great work which they will have to carry on, the several societies have provided that student branches may be established in engineering colleges. It is not desiring too much to expect the student members to model their procedure after that of the members of the national organization, but thus far, they have not succeeded in imitating the American Society of which they are a part. It is true that the student societies have functioned and have enjoyed successful years, but the success lay not in the papers prepared by their own members but in the papers prepared by men who were brought here from the outside and who were not members of the student branch.

The duty of the officers of the student chapter is to mould it into an organization that will approach its parent society. Hard work and perserverance in the matter of securing student papers to be read at the meetings of the societies would soon make the student organizations worthy imitators of the national societies, for students are capable of relating their experiences and expressing their opinions on some matters in a very creditable manner. A little effort and persuasion on the part of the officers is necessary to convince some students of this fact, but it can be done if the proposition is attacked and carried on in a business-like manner.

Certainly nothing could be more desireable than to have numerous student papers and discussions read throughout the year. The value of such practice to the student can hardly be estimated—the preparation of a paper demands of the writer careful analysis, minute

detail and accurate statements; the reading of a paper before an audience gives the reader poise, self-confidence, and experience which in time lends a certain natural inflection of the voice that carries with it conviction and certainty; the discussions require of everyone careful analytic thought lest they be intrigued by some fallacy; listening to the papers require of the audience ability to easily grasp the subject, rapid mental analysis of the statements presented, careful checks on the accuracy of the logic involved, and ability to discern immediately the true and proved statements from the uncertain and flimsy ones.

The value of such practice is evident without further words and it is hoped that the student members of the great American Societies will respond to the urging that they must feel within them, and devote a little time and study to work which will repay them immensely in that which the classroom cannot give; namely, expression, poise, self-confidence, ability to think for ones self and rapid development of that most valuable trait—personality.

A Non-Partisan Suggestion

A copyrighted article recently came into the hands of the editor which at great length elaborated on the reasons why engineers should support President Coolidge in the coming presidential campaign. Doubtless the author of the article was sincere in his statements that Mr. Coolidge would support much needed legislation in favor of engineers, if the engineers of the country would support him during the coming ten months. However it might not be at all unappropriate to ask Mr. Coolidge to win the support of the engineers by a little action now, rather than attempt to win it with a volume of promises.

Not long ago Secretary of the Interior, Work in a rather summary manner discharged Arthur P. Davis (Past President of the Am. Soc. C. E.), who was Director of U. S. Reclamation Service, with the statement that no more engineers would direct the federal reclamation, but instead a "business man" would be at the head of this important engineering branch of our federal government. To date the President seems to give his entire approval to the matter; at any rate he has not disapproved of the act, nor has he made any attempt to rectify the error of one of the members of his official family.

Laying aside all political alliances, anyone with the least bit of judgment would say that it is folly to expect the engineers to support the present administration until it has rescinded Secretary Work's action, and at least attempted to lessen the sting of his insult to the entire engineering profession. And it would seem to be far greater folly to expect to win the support of the engineers with many promises, when decided action in the right direction could rectify the gross blunder of Secretary Work and win back to the administration the confidence of the engineers. However, not for a moment will the engineers support the present administration as long as the action of Secretary Work is not rescinded either by himself or by the President.

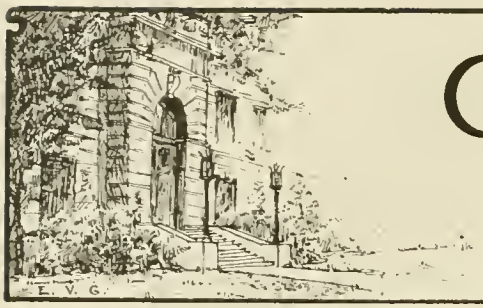
Activities in the College

The coming semester will see two outstanding opportunities for every engineer to take part in his college activities. Early in the semester the Engineering-Commerce debate will take place, and unless unexpected obstacles appear the proposed Engineers' Day will become a reality on April 4. Both of these events deserve the support of every engineering student and they offer opportunities for all to become better acquainted and take a more active part in the life of the campus north of Green Street.

Due to the efforts of a few men, a debate has been arranged with the commerce students. The teams have been chosen, a subject has been decided upon, and each side is working hard in the preparation of its arguments. The men on the engineering debate team deserve the support of every man in the engineering college, and it is expected that every engineer will be present on the night of the debate. It is only possible to make such events worth the time and effort spent in their preparation, when the students turn out in a body and support them. Let not the hopes of the few who have sponsored the debate be destroyed by a lack of interest on the part of the engineers.

The last few graduating classes have hoped to see the establishment of an annual event

(Continued on Page 101)



COLLEGE NOTES

PROPOSED ENGINEERS' DAY

In order to create a spirit of enthusiasm and a greater spirit of friendship among the engineering students, the Engineering Council is carrying on arrangements with the faculty for an Engineers' Day which will be observed in a fitting way with an eventful program. The Faculty Committee and Engineering Council have perfected the plans for the day, and they need only the approval of the Council of Administration before taking definite steps toward arranging for the event. If present plans materialize, as it is believed they will, Engineers' Day will be celebrated on April 4, and the following program will be carried out:

The Engineering Parade

All classes will be dismissed at 2:50 P. M. At 3:00 P. M. a parade led by the University Band will be held through the University District in which every engineer will march. Each department in the college will be represented by a large float which the students must work up. The float may depict any engineering event or development which a department may choose, provided that the float lends beauty and dignity to the parade. The department with the best float will receive a trophy for their efforts, and a picture of the float will be run in the Technograph.

The Engineering Assembly

The parade will end at the Auditorium where the Engineering Assembly will be held. A nationally renowned engineer will be secured by the faculty to address the students on this occasion. Arrangements will be made with the University Broadcasting Station, WRM, to broadcast the address so that engineers everywhere may enjoy our first annual Engineers' Day.

The Engineering Dance

In the evening the annual Engineering Dance will be held, and every effort will be made to make it the greatest ever. Novel decorations, delightful surprises and good music will feature the dance and conspire to make it eclipse our dances of the past.

It All Sounds Fine But—

It is up to every engineer to help make our first Engineers' Day a success. The faculty can be relied upon to get a speaker that will justify filling the Auditorium with listeners. Engineering Council and the Dance Committee will see to it that the dance is the greatest ever. Then if every engineer will see to it that his department has the best float possible, and will then make sure that he and all of his friends are in the parade, the Engineers' Day will be a great success.

No one is going to be asked to do a great deal, but everyone is going to be asked to do something, and Engineering Council and the faculty feel that every engineer is loyal to his college and will respond when he is called. Every engineer that is loyal to his college and to his department will turn out and help, and each one will strive to make his department have the best float in the parade.

Get Interested

Ask your Society President about the proposed Engineers' Day. Let him know that you are interested, and pledge your support in whatever he does. If everyone does the little that is asked of him, the first Engineers' Day will be so successful that faculty and students alike will eagerly look forward to it next year.

ALL-ENGINEERING SMOKER

The All-Engineering Smoker was held on the evening of December 14, in the Illinois Union Building. A carefully prepared program was carried out and the event was well attended. A couple of Coach Paul Prehn's undergraduates put on a boxing match that brought cries of approval from the audience. It was followed by a fencing match between Captain N. E. Sowers and W. H. Nelson, both of the Varsity fencing team. Sowers explained the sport to the

crowd before the event, and then proceeded to show the fine points of the sport to them.

Professor Emeritus Ira O. Baker of the civil engineering department was the speaker of the evening. In his talk Dr. Baker pointed out to engineers the necessity of branching out into other things than those purely technical, if they intended to become a success in their profession. He spoke, from experience with former students, of the causes of success and of failure in the profession, and it is certain that everyone who heard Dr. Baker's speech will go out of the University with a store of advice that will be of considerable value to them if they will only heed it.

After Dr. Baker's talk, the doors to an anteroom were thrown open and all were invited to partake liberally of smokes, and of cider and gingerbread. The Smoker was carried out under the supervision of Engineering Council. Many thanks are due to C. E. Sperry and his committee, who took charge of all the arrangements.

ENGINEERS IN ACTIVITIES

One of our most prominent engineers is Clifford S. Strike, m.e., '24, who bears the title of Business Manager of The Daily Illini. "Cliff" was local advertising manager last year and he is a member af Sachem. We have a right to feel proud of an engineer who can submit to the strenous life of supporting the business end of a live daily and also manage to keep up with the regular required work in good shape.

C. S. Strike

R. C. Tower, g.e., '25 is another promising engineer. He is a junior in general engineering and at present he is local advertising manager of the Illini. Bob is a preliminary honor man and in addition to his other accomplishments he is a member of Sachem.

H. W. Schlechter, c.e., '25, was stage manager of the production "Captain Applejack."

W. H. Clingman, e.e., '25, is managing editor of the 1925 Illio. Who said engineers could not manipulate the mother tongue? Also Bill is one of the fifteen juniors who received preliminary honors in the College of Engineering.

C. W. Goodman c.e., '25, was a member of the Junior Prom Committee.

Paul N. Duca, a.e., '25, spent many a wee small hour in painting scenery for "Captain Applejack."

W. W. McIlwain, m.e., '25 football veteran is also a member of Sachem.

R. W. Brady, ry.e.e., '21, is a lieutenant-colonel in the cavalry.

"Milt" Angier, e.e., '21, is president of Tribe of Illini.

Ken Pierce, c.e., '25, is a member of the Illini Board of Control.

C. R. Bronski, e.e., '21, is a Lieutenant-Colonel in the Signal Corps.

N. E. Sowers, g.e.p., '24, is captain of the fencing team this year. He succeeds G. V. Nelson, e.e., '21, who was captain last year. W. H. Nelson, e.e., '25, is also fast with the foils and bids fair to equal the performances of his brother engineers. Sowers and Nelson, the junior, put on a fast exhibition to entertain the boys who attended the Engineering Smoker.

Engineers are well represented this year on the varsity squads of the major sports, and those names listed below are some of the engineers who are fighting to keep Illinois in the lead in athletics.

Wrestling is represented by five men: C. H. Bates, e.e., '26; R. K. Dupee, e.e., '26; J. W. McMillen, min., '24; A. C. Tosetti, e.e., '26; and M. S. Luthringer, e.e., '25.

The basketball squad has but a single engineer, —J. R. Broderick, e.e., '26.

Of ten men on the water basketball squad, five are claimed by the College of Engineering. They are: W. E. Schroeder, Jr., m.e., '26; F. B. Powers, e.e., '26; J. L. Hamilton, Jr., arch, '26; W. M. Pearson, arch., '24; and C. C. Price, e.e., '25

The track team claims more engineers than any other sport, and the nine engineers who have made the squad are listed below:

M. S. Angier, e.e., '24; C. L. Abney, cer. e., '25; R. D. Kell, e.e., '26; T. W. Oliver, e.e., '25; A. C. Rehm, g.e., '25; F. R. Roberson, arch., '26; T. C. Stresser, ry.m.e., '26; C. V. Talley, e.e., '26; and R. F. Wickoff, m.e., '26.

H. Schlenz, arch., '27, capably filled the position of chairman of the Freshman Frolic, and under his guidance the event was one of the most successful ever held.

Committees have been chosen for the Senior Memorial, and the engineers serving on these committees are: G. O. Bates, e.e., '24; R. N. Woods, e.e., '24; R. A. Patterson, ry.e.e., '26; E. C. Johnson, min. e., '24; E. E. Armory, g.e., '24; R. H. Hoge, e.e., '25; C. H. Becker, e.e., '24; H. G. Swanson, m.e., '24; J. W. McHugh, cer.e., '24; F. S. Markett, cer.e., '24; and P. R. Wilson, m.e., '25; H. E. Wessman, e.e., '24; A. G. Dixon, g.e., '24; and R. D. Webb, m.e., '24.

FRATERNITY ACTIVITIES

Tau Beta Pi

Eleven seniors and one junior were initiated into Tau Beta Pi, honorary engineering fraternity, on December 5th. The formal initiation was held in Philomathean Hall and the banquet at the Urbana-Lincoln Hotel. About 30 faculty members were present in addition to the student membership. The names of the initiates were published in the last issue of the Technograph.

Prof. H. E. Moore functioned as toastmaster. The following program was given: "Welcome," by H. E. Wessman; "Response," by R. D. Webb; "Revelations," by G. G. Robinson; "The Inventor, the Scientist, and the Engineer," by Prof. E. B. Paine; "Entropy, Athletics, and Scholarship," by Prof. G. A. Goodenough; and "Vision," by Prof. J. M. White.

On November 1st, Tau Beta Pi held its annual open meeting for all engineering students in Room 221, Engineering Hall. Only a handful of students turned out to hear a program that merited a record-breaking attendance. H. E. Wessman, president of Tau Beta Pi, presided over the meeting and introduced the speakers. The first talk, "History of Tau Beta Pi" was given by Prof. M. L. Enger of the Department of Municipal and Sanitary Engineering. He told of the reason for founding and briefly sketched the development of the society from the time it was organized at Lehigh University in 1885 by Prof. Edward C. Williams. There are now forty-two chapters, with a total membership of 11,000.

The second talk "Aims and Ideals of Tau Beta Pi" was given by H. H. Jordan, Assistant Dean of the College of Engineering. He stated that Tau Beta Pi is the ideal for which undergraduates should strive—for it marks in a fitting way those students who are a credit to their institution. He emphasized the fact that the honor society stimulates the individuals to achieve high scholarship—and that after its ranks are attained, the student is further stimulated to go on in life and set up a continually growing ideal.

Dean M. S. Ketchum gave the third talk, "The Value of Achievement." He presented some very interesting statistics compiled from an investigation of a number of successful engineers in 1918. The report indicated that the majority of those, who were rated as successes, had made very good grades in college, and consequently the conclusion was drawn that he who achieves in college has a much better chance of attaining success in life than the poor student has.

The last talk, "The Status of the Engineer," was presented by Dr. I. O. Baker, Professor Emeritus of Civil Engineering. The point that engineers as a rule are very one-sided men, was strongly emphasized by Dr. Baker. Too many students cultivate technical knowledge alone and as a result they are narrow and lack breadth of view. They have failed to balance engineering study with other highly desireable knowledge. They cannot express themselves clearly and forcefully, and as a result, projects, commissions, and committees involving engineering problems are very often under the control of lawyers, business men, etc.—instead of being as they should be, under the leadership of engineers. The value of writing for publication, the value of speaking before crowds, the value of extensive reading of history, great works of fiction, etc., were stressed by Prof. Baker. He concluded his speech with an illustration of what writing did for one man, a plea for engineers to start broadening out while in school.

Theta Tau

Theta Tau, professional engineering fraternity, held its formal initiation at the Wesley Foundation on Thursday, November 15, when nineteen engineers were admitted to membership. The initiation ceremony was followed by a banquet at the Inman Hotel, which was attended by more than fifty faculty and student members. J. E. Brennan was toastmaster, and he introduced the following speakers: C. H. Dodge, Address of Welcome; M. N. Quade, Response; Professor E. E. King, A Charge to New Members; Professor O. A. Leutweiler, The Aim of a Professional Fraternity; J. R. Welsh, Friendship; and E. C. Johnson, Humorous Memories.

Prof. Leutweiler's speech will long be remembered by all who heard it, and his formula for success will bear repetition. He reduced the famous old mechanical engineering formula for indicated horsepower to the following form:

$$p\,l\,a\,n\,k = \text{I.H.P.}$$

in which, p is perserverance, l is loyalty, a is accuracy, n is nobility of character, and k is knowledge. This plank equals "important high positions," as shown in the formula.

At the dinner meetings which are held every two weeks, the usual program of professional talks has been carried out. At the meeting on November 22, H. E. Herting, c.e., '24, spoke on "Summer Experiences," and J. Robert Welsh, c.e., '24, spoke on "The Imperial Valley and The Colorado River," at the meeting on December 6.

E. C. Johnson, min.e., '24, was elected delegate to the national convention, which was held at the University of Iowa, during the holidays.

Sigma Tau

Theta Chapter of Sigma Tau, honorary engineer-

ing fraternity, announces the following initiates into its membership:

W. A. Rolleston, '24, R. J. Pfeifer, '24, A. B. Young, '24, R. G. Johnson, '25, A. L. Tholin, '24, G. V. Nelson, '24, C. E. Erickson, '24, J. E. Inman, '25, C. T. Parker, '24, G. G. Robinson, '24, L. A. Mollman, '25, J. C. Koonz, '25, R. S. Condon, '24, E. R. Troche, '25, W. G. Roesch, '25, J. W. Romig, '24, I. L. Peterson, '24, T. E. With, '24, A. L. Smith, '24, J. W. Schaefer, '25, J. W. McHugh, '24, and E. R. Brauner, '25.

Tuesday night, November 27th, an informal initiation was held at White Heath on the banks of the Sangamon River. Needless to say, it was very informal. On Wednesday night, November 28th, the formal initiation and banquet was held at the Inman Hotel. About 50 student and faculty members attended. "Art" Dixon toast-mastered and called for talks from "Milt" Angier, "Blondie" Wessman, Prof. MacIntire, Dean Jordan, and Prof. Provine.

OUR CONTEMPORARIES

The "Michigan Technic" displayed an interest in the University of Illinois Experiment Station in the issue of November, 1923, when they published quite an extensive article by Professor H. F. Moore on the Fatigue of Metals. The article emphasizes the nature of the fatigue of metals tests and the work being done in the study of this phenomenon. Prof. Moore is in charge of the fatigue of metals laboratory and has already published a number of bulletins on his work. The study of the fatigue of metals comprises one of the foremost problems of strength of materials, and the work carried on at the University of Illinois Experiment Station has shed much light upon the subject, and has been an invaluable contribution to the engineering profession.

The article has two important features of interest to students here; namely the wide publication being given to the fatigue of metals work and the advisability of college professors writing for the technical journals of other schools. The latter is especially important since the life of the technical publication is due to a large extent to the new vitality instilled by those outside our routine work.

"The Engineer" from London in the issue of October 26th, 1923, had occasion to mention the engineering college of the University of Illinois to considerable extent. One of the most striking features of the article is the mention of an atmosphere of academic peace which pervades our University. To quote directly, "Here, even more than at Ann Arbor, the life and activities of the university are removed from the industrial pressure which is exerted upon some universities of the east, and the pursuit of learning and knowledge is much less hampered accordingly."

The article also deals with the work of Prof. Moore in the fatigue of metals, Prof. Talbot in concrete, Prof. Washburn in ceramics, Profs. Brown and Knipp with alkali vapour tubes, and Prof. Watson in accoustics.

ENGINEERING-COMMERCE DEBATE

The College of Engineering and the College of Commerce have established a new precedent by arranging a debate. The subject has been agreed upon as "Resolved, That the proposed one hundred million dollar road bond issue of the State of Illinois be approved by the voters of the state."

The defendents of the College of Engineering are: H. E. Wessman, c.e., '24; W. H. Thoman, c.e., '24; E. B. Johnston, m.e., '24; and alternate, P. W. Emley, e.e., '26. The members of the College of Commerce team which is to present the affirmative are: L. U. Cohen, '24, W. C. Carpenter, '24, F. W. Sanders, '25, and alternate, J. W. Wright, '25. The debate is scheduled for sometime in February.

BOOK REVIEW

ENGINEERING DRAWING
By Jordan and Hoelscher

This text book is compiled by H. H. Jordan, B.S., Head of the Department of General Engineering Drawing, and R. P. Hoelscher, B.S., Assistant Professor of General Engineering Drawing, both of whom are located here at the University.

This book has been written to bring together the many bits of knowledge of engineering drawing, but which have heretofore, only been obtainable in isolated particles. The methods and technique, are in accordance with the latest and most modern practice, and in the same respect all machines and instruments illustrated, are the latest designs in engineering drawing practice.

Illustrations and descriptions are not skimped, but are full and well rounded out in a manner that makes the subject interesting and easily understood by the student. Many features have been included, which for some reason the average text book wholly excludes, or gives but just a word or brief mention. Among these features are: The Reproduction of Engineering Drawings; Chart and Diagram Drawings; Map Drawings; Architectural and Structural Drafting; and Patent Office Drawing, together with a complete appendix containing geometrical constructions, symbols, tables, and pipe lay-outs.

The book ideally lends itself to the class room in being in simple English, and in having complete chapters which are just long enough for one lesson, and so do not carry over from one class period to another. The material is so divided that only the most important is emphasized, and if so desired the secondary matter may be omitted without destroying the continuity of the topic dealt with. A liberal amount of the essential cuts have been used to illustrate the text matter, and each cut has embodied in it the proper technique and execution. Stereotyped phrases and problems have been omitted, making it possible for drawing departments to retain their local color and originality. A clean cut distinction is made between elements of drafting and elements of design. None of the latter are employed in Part I, and in Part II, no technical design is used, making each part a well defined unit.

The book contains 351 pages 6 x 9 inches. There are 294 figures in the text matter, and numerous others in the appendix. John Wiley and Sons, Inc., are the publishers.

Some Economic Aspects of Superpower

(Continued from Page 69)

would enable them to use the advantages of large capacity generators. But would this be the right program for us in view of the importance of our resources and the fact that they are limited?

While it does not offer a panacea for all the ills of the coal industry, super-power offers at least a basis for development. I have tried to show the evils of wasteful fuel consumption and some of the possibilities of central stations linked in an efficient chain. I have also noted that super-power chains are in operation in the denser industrial regions of the country. Their development will be hindered by many problems and we must be prepared to meet them.

I think we can resolve it down to this—are we going to allow this vital industry to "just grow," like Topsy? Or are we going to plan for it's development in a definite logical manner? So far its sponsors have had an uphill struggle against lack of public interest, difficulty in securing capital, unsympathetic commissions, etc. I think the recent investigation of the U. S. Geological survey marks a favorable change in the attitude of the powers that be, and it is hoped that in the near future super-power will come into its own.

[1]"America's Power Resources"—Gilbert and Pogue.
[2]From a lecture by Prof. Parr to the University of Illinois Mining Society.
[3]"Production of Power in the Mississippi Valley" Samuel Insull.
[4]"The Future of Water Power"—Wm. Morgan.
[5]Electrical World. November 5, 1921, pp. 917.

The Sandslinger Molding Machine

(Continued from Page 80)

—can make 320 molds per day. At the Ford Motor Co. one Sandslinger does the work of twenty men. On another engine job, which is being produced, one tractor Sandslinger and five men made 90 molds in four hours. Two stripper plates were towed behind the tractor, one for the cope and the other for the drag. As one mold was being rammed the other was being stripped, etc. One great saving in the time of molding operations which is especially noticeable in the production of gas engine molds is due to the fact that no gaggers are needed when the molding is done on a Sandslinger.

As already stated the size or shape of the pattern has no effect on the efficiency of the machine. It can ram large molds as well as small ones. Fig. 2 shows one of the larger jobs being molded (bathtub). On this job besides saving men, fifteen pounds of metal was saved on each casting.

There are three reasons why there is a saving of metal when a Sandslinger is used for molding. The first reason is that the mold is rammed with absolute uniform density. The second is that in ramming with a Sandslinger no excess strain is put on the flask or equipment. The third reason is that with a Sandslinger the mold can be rammed much dryer and therefore it can be rammed much harder than can be done by hand or with a jolt machine. A mold that is rammed hard and with uniform density will produce a casting true to pattern. Where production is on a large scale a saving of a few pounds of metal on each casting means a great deal; and in the machine shop, a few pounds less of metal to machine off also means a great saving.

The actual mechanism of all four types of Sandslingers are almost identical, in so far as the method of handling the sand, after it has been dumped onto the sand screen by the bucket elevator, is concerned. The whole conveyer chute is made to oscillate to the right and left by the motion of the shaker arm that is fastened rigidly to the rocker arm of the four link mechanism. This mechanism consists of the crank, connecting rod, rocker arm and the frame of the machine. The motive power is supplied by an electric motor; in fact all the operations are done by motor power. The oscillating action of the conveyer chute riddles the sand through the sand screen from where it slides into the receiving hopper. From there it is conveyed to the impeller head by an endless belt and from there it is thrown into the flask.

The gaggers or any scrap that was dumped with the sand onto the screen, slide down the chute into the scrap box.

ELECTRICAL SHOW NOTE

A reformer says he has lamped the current styles in bathing suits and found them shocking. And Watt's more, their scandalpower is high.

BELLE: "Did you make any money at the poker last night?"

DUMBELL: "I'll say I did. Joe won enough from me to pay what he owed me."

"Father, what is a sinking fund?"

"The place where they hide the profits from the stockholders."

BANK CASHIER *(to flashily dressed colored woman)*: "You wish to borrow an additional sum? I'm afraid you are spending too much money on your wardrobe."

COLORED WOMAN: "Lawdy, suh, Ah wish you could see it! It ain't got but one door an' that's off the hinges."

IT'S ALL IN THE POINT OF VIEW

"Come down (hic) an' ope' the door."

"It's unlocked. Pull out on it," came from the second story window.

"Can't. I'm leanin' 'gainst it."

CO-ED *(to home town grocer)*: "Can you tell me if there are any vitamines in this lettuce?"

"Well, mmm," replied the native, "There's bound to be a few insects on most garden truck but there ain't no reason in the world why you can't wash them off, if you've a mind to."

"OH! Oh!" *(in decreasing murmurs.)*

WHERE CAN WE GET SOME MORE?

"Your medicine has helped me wonderfully," wrote the grateful woman, "A month ago I could not spank the baby and now I can thrash my husband. Heaven bless you."

ALTRUISM

INTOXICATED STUDENT *(as car leaves road)*: "Oh, Lord, I don't ask anything for myself but don't wreck dad's car."

—*West Virginia Moonshine.*

At the colleges, kiss-stealing is known as petting-larceney.

HUSBAND *(starting off on a deer hunt)*: "I'll bring you back a handsome deer head for over the mantel in the library."

WIFE *(true to form)*: "Oh, do get one with intelligent eyes."

DUMB: "Why does a divorce suit remind you of ruined lingerie?"

BELL: "I'll bite."

DUMB: "It's the ripping of a combination."

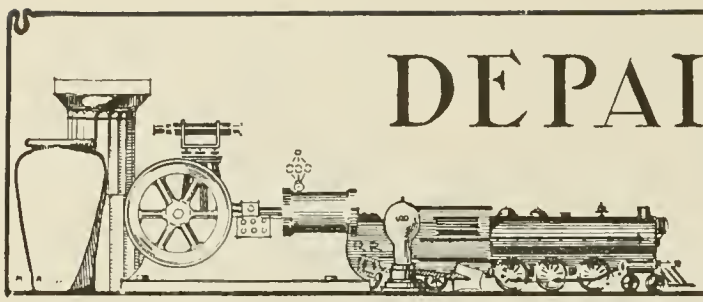
It's the little things of life that tell—as she dragged her kid brother from underneath the sofa.

ADVERTISEMENT: Why kill your wife? Let our washing machine do your dirty work.

THEY WENT

HE: "Darling, I've made up my mind to stay at home tonight."

SHE: "Too late, I've made up my face to go out."



DEPARTMENTAL NOTES

Architectural News

Department News

The department of architecture is exceedingly pleased with the results in the Beaux Arts Institute of Design work.

The subject of the first problem this year in senior design was a Public Library. The results netted Illinois five first and four second mentions. This places the University of Illinois, as far as "class A" design is concerned, among the four highest. The other three schools being Carnegie Institute, Pennsylvania and Columbia. The men who received first in this judgment are: E. H. Mittlebusher, W. E. Armontrout, E. I. Harrison, A. B. Gallion and R. A. Mattson.

The juniors and sophomores are also taking the Beaux Arts problems. The juniors' first problem being "A Stadium Entrance." As the awards are fewer in "class B" work, E. Newcomb was the only junior who obtained a first mention. T. C. Hedrick received a first mention in the sophomore problem, the subject of which was "A Well Head."

Scarab

The Scarab fraternity is at present occupied in planning its activities for next semester. Several smokers and talks are being scheduled which should take place shortly after vacation. The date of the Scarab Medal Competition will also be announced at that time.

The Architectural Society

The last smoker given by the society, on December 6, stands as a proof that there really are worth while smokers. The talk given by Mr. Willis of Champaign, on the subject of business, was an interesting variation from the usual technical lecture. A great deal of credit is due the officers for the excellent showing that the society is making this year.

Gargoyle Society

Gargoyle society, honorary architectural fraternity, has enjoyed an active and successful semester under the leadership of R. J. Pfeifer. Formal initiation of the new members took place at the Urbana-Lincoln hotel Wednesday evening, December 12, 1923. Dean Ketchum was the guest of the society at the initiation banquet and the principal speaker of the evening. Short talks were given by Professors Provine and Newcomb, while Professor Palmer acted as toastmaster. The following men were initiated: J. C. Arntzen, a.e., '25, J. A. Boyd, a.e., '25, W. E. Fraser, arch., '25, H. E. Holmes, a.e., '25, W. D. Sorgatz, arch., '24, E. G. Spencer, a.e., '25, and R. D. Wilson, a.e., '25.

Tuesday evening, December 18, Gargoyle Society held an open meeting with the freshmen and sophomores of the department as invited guests. Dean Jordan was the speaker, and Harford Field '24, read his Ricker prize paper on "The Development of the Dome." The main purpose of the meeting was to announce the establishment of a prize to the freshman having the highest standing at the end of the second semester in both architecture and architectural engineering.

Ceramic News

American Ceramic Society

The American Ceramic Society established a tradition last month, when the first annual ceramic pig roast was inaugurated. The kiln house was the scene of the festivities attended by about eighty "Bricklayers." All the food was cooked barbecue style and everything that it takes for a pork dinner was present.

After the roast many expressions of self disgust were heard from the boys, as a consequence for consuming such mammouth portions of the repast. However, there were many friends in common and each offender had a "rip-roaring" time.

The smashing success of the pig roast was mainly due to the untiring efforts of G. S. Smallwood.

The ceramists borrowed the idea from the Ohio State branch of the American Ceramic Society. The annual ceramic pig roast at Ohio State is considered one grand event.

In connection with the meeting of the society, Professor Newcomb, of the department of architec-

ture, gave a very interesting illustrated lecture on "The Development of the Ceramic Art with Architecture." Prof. T. T. Quirk, head of the department of geology, also gave an illustrated lecture at another meeting of the society. He spoke on the work of the geological survey in Canada.

Department News

Some very good pottery work was turned out in time for Christmas by H. F. Bopp, '24, and J. W. Hall, '24. Incidently, the work was placed on display in the Engineering Library for several days. In this exhibit were some very good green glazes which the two men developed.

The Ceramic Short Course

January 14 will mark the opening of the biennial short short course in clay working and enameling conducted by the department of ceramics. The courses of instruction will extend over a period of ten days, from January 14 to January 25. They will consist of lectures, laboratory work and informal discussions.

The courses are designed to meet the requirements of practical men. Officials and plant representatives interested in the various phases of ceramic industries will be present.

A number of department representatives and instructors in ceramics will lecture as well as several visitors. R. R. Danielson, of the U. S. Bureau of Standards, Washington, D. C., R. M. Howe, of the Kier Fire Brick Company, Pittsburg, Pa., and A. S. Watts, head of the department of ceramic engineering at Ohio State University will be the visiting lecturers.

Civil Engineering News

Department News

It is with pleasure that we call your attention to the work of Prof. W. M. Wilson in a new book, "Stresses in Framed Structures," recently published by the McGraw-Hill Company. This book was edited by G. A. Hool and W. S. Kinne, professors of structural engineering at the University of Wisconsin. Several eminent engineers have collaborated in supplying the material for this work. Prof. Wilson has written a section, 160 pages long, entitled "Statically Indeterminate Frames." The fact that he was chosen to write this section is a tribute to his reputation in this particular line of work.

Prof. Wilson is also carrying on an investigation of large, segmental rollers, besides performing research work on a 135 ft. reinforced concrete arch near Danville over the North Fork of the Vermilion River.

A roller with a diameter of 60 feet for the segment is now being ground in preparation for investigation. The segments are being contributed by the American Bridge Company. The committee on Iron and Steel Structures from the American Rail way Engineers Association is co-operating in this research.

On the aforementioned concrete arch, temperature effects such as the resulting stresses in the steel and concrete, and the changes in shape of the arch rib are being noted. This work is being performed in co-operation with the committee from the American Society of Civil Engineers on Concrete and Reinforced Concrete Arches.

J. M. Hardesty and George Keranen, graduate assistants, are helping Prof. Wilson in his investigations.

Prof. T. D. Mylrea of the structural engineering department, assisted by Mr. C. B. Schmeltzer, instructor in surveying, Mr. F. E. Bauer, instructor in highways, and Mr. L. E. Grinter, graduate student, is doing research work on impact in highway bridges.

Our Inspection Trip

Portrayed by H. E. Wessman, '24

Forty-five strong, we civil engineers, under the guidance of Professors Hardy Cross, T. D. Mylrea, and Jamison Vawter, descended upon Chicago the night of October 23 for our annual sightseeing tour. Reveille was blown in the lobby of the Fort Dearborn Hotel at 6:30 o'clock on Wednesday morning and after Sergeant Mylrea called the roll and found all present or accounted for (in bed) we took a train for Gary and did not stop until the works of the Indiana Steel Company hove in sight. Here we followed the steel process from the ore docks to the shipping yards. In the afternoon, after going two miles west, we found the plant of the American Bridge Company in our way and learned "everything" about the fabrication of anything you want in the structural steel line.

Thursday morning, after the usual roll call, the gang went up to the Lake View Pumping Station and saw what a good housekeeper can do in a pumping plant. They certainly had the decks "holystoned" to the *n*th degree. After sampling some of their water dosed with chlorine, we went up to Evanston and after passing up all the Northwestern co-eds, stopped at the north end of the campus and sampled some of the water purified with chlorine which had just emerged from the filtration plant. Incidently we learned that in practice they still build filter plants with "sloppy" concrete. After lunch at one of Thompson's "hash-houses for the elite" we assembled at the site of the New Union

Station, in Chicago. It's going to be a wonderful thing when completed. About 95 percent of us found out here, that Chicago already has an underground railway. Don't see why all the argument for a subway when they already have one.

Friday morning we visited the lake front and saw Chicago's new municipal stadium. Then we journeyed along the Illinois Central tracks until we reached the Strauss Building on Michigan Boulevard. On the way we saw an overhead bridge with a center pier highly fatigued. The aforesaid reaction had settled, thereby making the structure highly indeterminate. We left it that way. They were very nice to us in the Strauss Building. After showing us extremely heavy columns and massive girders, they took motion pictures of us. We understand the movies are being shown all over Chicago.

In the afternoon, we came back to earth again and inspected the fills along the Rock Island Lines south of Chicago. Interesting track elevation and grade separation work has been done out there. A concrete crib made of precast concrete units is an interesting type of retaining wall used on this work. We also went down and viewed the Calumet-sag channel, which carries all the sewage from that part of Chicago, south of 87th Street. Not as beautiful a stream as some I've seen.

This tale would not be complete without a reference to the banquet we had Friday night at the Fort Dearborn Hotel. About 50 alumni civil engineers were present for the highly successful affair. "Blondy" Wessman was toast-master and took the opportunity to tell our guardians, Professors Cross and Mylrea just what he thought of them. Needless to say they responded. We also enjoyed hearing from E. S. Nethercut, Secretary of the Western Society of Engineers, Prof. W. A. Knapp, '07, of Purdue; Merle J. Trees, '07; A. J. Schafmayer, '10; J. T. Hanley, '07; O. E. Strehlow, '96; C. S. Pillsbury, '07; C. H. Mottier, '10; A. R. Black, '23; and "Bob" Welsh, '24.

Saturday morning, we turned sailors for the time being and navigated the Chicago River even as Father Marquette did years ago. But what a difference. No trunnion or rolling bascule bridges lifted themselves then as they do now. On the Michigan Link Bridge, we were all treated to the sight of a collision between these modern, high-powered automobiles, which travel fast and skid furiously in wet weather. No casualties, however. But like all vacations, this one had to come to an end, and we finished up like true Illini by watching our football team beat the tar out of Northwestern. So goes it.

A. S. C. E. Notes

On November 28, 1923, Clifford Older, chief highway engineer, State of Illinois Division of Highways spoke under the auspices of the Student Branch of the American Society of Civil Engineers before a large gathering in Room 221, Engineering Hall. His topic was "Highways, Today and Tomorrow."

Mr. Older told some of the conclusions reached from the recent Bates Road Experiments. Although a rational method for design of highways is by no means yet attained, the Bates Road Experiments did much to dispel previous illusions and place highway design at least on a sane basis. The soil experiments showing the depression of the subgrade from the slab under repeated loads, especially during freezing and thawing, and the observations of warping due to temperature changes, both indicated and proved that the edge of the slab is unsupported much of th etime and consequently acts as a horizontal cantilever. It was conclusively proved that the edge strength of a concrete road should be greater than the center strength, and as a result we have the new State of Illinios design with a 9 inch edge thickness and a 6 inch center thickness. Although, a rational formula has been derived for the edge thickness, there is no rational method of design for center thickness, and the engineers have based the final design so far as the center is concerned upon load tests. Tests of the new section have thoroughly demonstrated its practicability.

On December 12th, Mr. T. C. Shedd, associate in structural engineering, gave an interesting illustrated lecture on "Principal Steel Bridges of the World." The hour between four and five o'clock was thoroughly enjoyed by a crowd of students and faculty completely filling Room 221. We saw pictures of most of the famous steel bridges of the world, representing a multitude of types, and heard a word of explanation in connection with each one. May the rest of our meetings be as interesting as this one.

Although getting off to a rather slow start, the A. S. C. E. is now functioning smoothly and the meetings are well attended. The only drawback is the fact that our membership, about 60, is composed largely of upperclassmen. We hope that more of the underclassmen amongst the civils will come with us before the year is over, for the meetings are of value to all and one who does not take part is losing a vital part of his college course.

Chi Epsilon

The formal initiation banquet was held at the Inman Hotel, November 19, 1923. One senior and nine junior civil engineering students were initi-

ated. The names of the men appear in the last issue of the Technograph. After a substantial menu, Toastmaster Thoman opened the barrage with a few scattering shots and then introduced the heavy artillery. Dean M. S. Ketchum, who responded with a valuable talk on "Engineering Research," was the first to speak.

Following are some of the high lights of his address:

"There has been a wonderful growth during the last 25 years in the science of civil engineering. Much has been accomplished in research, but there are still many opportunities for research in various lines of engineering."

"Engineering research offers a good opportunity for those who want to do something."

"The engineering experiment station at the University of Illinois has accomplished much in research. It was the first station of its kind in the country, and, although there are stations established now in many technical schools and land grant colleges, none have accomplished as much as the experiment station here at the University of Illinois."

Prof. C. C. Williams, Prof. Hardy Cross, and Prof. T. D. Mylrea also added a few remarks along similar lines.

F. W. Scheinman, '22, now with the engineering department of the Illinois Central Railroad, told of the origin of Chi Epsilon at Illinois.

The burden of proof was then taken up by the students and John Clausen, '24, and M. N. Quade, '25, gave short talks, after which the highly successful banquet adjourned.

Electrical Engineering News

Department Notes

The Seniors received some interesting information when R. E. Cunningham, '02, Superintendent of Distribution for the Southern California Power Company gave an interesting talk on some of the problems connected with the line operating at 220,000 volts, which is the highest voltage in use to date. The line is about 220 miles long and conducts power from near the Yosemite Valley to Los Angeles. It was formerly operated on 150,000 volts and was converted by adding two insulators and one steel ring to each string thus giving eleven insulators and one ring as protection. The wires are about 19 feet apart. The line has been in operation at this voltage about a year and is giving satisfactory results. It would seem, however, that voltages much above this are not practical for power transmission, according to Mr. Cunningham, due to the corona loss. Another interesting feature of the line is that a frequency of 50 cycles is used.

Dr. E. J. Berg of Union College and consulting engineer of the General Electric Company gave a series of talks, November 7, 8, and 9, on Heaviside's expansion theorem. Heaviside's operators offer an interesting method of solving the problems ordinarily handled with differential equations. In many cases the use of differential equations gives the results in such shape that they cannot be applied to the problem under consideration. Heaviside's theorem, on the other hand, leaves the results in practical form. The great advantage of Heaviside's theorem lies in the solution of problems involving transient phenomena as it is the only satisfactory method of dealing with these problems. Problems involving transients are at the present time among the most important in electrical engineering. There is no doubt but that Heaviside as presented by Dr. Berg is interesting and useful while Heaviside without an explanation is nearly beyond comprehension.

While here Dr. Berg gave an interesting lecture on "Reminiscences of Steinmetz" before a joint meeting of the E. E. Society and the A. I. E. E. Having lived with Steinmetz for several years, Dr. Berg spoke from experience and related many interesting incidents in the life of the renowned engineer.

Charles Proteus Steinmetz was born in Germany and had little chance to play as a child as he was always crippled. This fact, according to Dr. Berg, was probably responsible for the intense enjoyment he derived from play throughout his life. His activities in Germany were along Socialistic lines as he was editor, composer, and printer of a radical paper. These activities made it necessary for him to leave Germany, and he fled to Switzerland, where he continued to publish his paper. Soon afterwards he evaded the Swiss authorities and came to the United States. He arrived penniless and was given a position with the Eichmeyer Electric Company in New York. His early scientific and mathematical training became of use, as he started to work in electricity. Later the company for which he worked was bought by the General Electric Company on the condition that Steinmetz come along. From that time until his death he was consulting engineer with the latter firm.

The Steinmetz method of analyzing a problem was mathematical, thus giving results which were theoretically correct. In this way his method is much different from that of Edison's, which consists of solving problems largely by experiment. Steinmetz's determination of the hysteresis exponent was based, however, on the results of a great many experiments. This discovery alone made him famous.

For several years he and Dr. Berg maintained a small zoo in Schnectady which was a source of great interest to the children of the town. Steinmetz, as stated before, liked to play, especially with children and usually spent his summers camping with one or more of them. He also appreciated beauty in nature and in fact in anything. As an example of this, Dr. Berg said that they frequently gave dances for their many young friends and Steinmetz usually spent the evening talking to the prettiest girls present. Dr. Berg's talk was interesting and appropriate, coming as it did, soon after the death of the noted engineer, which occurred October 26, 1923.

Prof. J. T. Tykociner gave a talk December 13th, 1923, on some of the results of his research in the field of radio. In order to carry out this research it was necessary to use models due to the cost of full-sized equipment, and to avoid interference from commercial stations. The first problem was to build model antennas, which was comparatively easy. However, in order to have similar comparable conditions, it was necessary to produce waves proportionately shorter. The models were one hundredth size so the frequencies required were 100 times as great as in ordinary use. These Herzian waves were produced by the hot cathode vacuum tube at a frequency of 50 to 100 million cycles per second, with corresponding wave lengths of 6 to 3 meters.

In order to measure these waves it was necessary to construct a special wavemeter, so this was done. With these two pieces of apparatus, Prof. Tykociner has done considerable work in measuring the constants of various types of antennae. This field of radio is at the present in an uncertain state due to the fact that the performance of various antennae cannot be calculated with certainity, as can the performance of the tubes now used in the generation of waves. It is true that there have been only three steps in the development of antennae. The first was discovery of wave transmission; the second was Marconi's vertical antennae with consequent modification of inverted, "L," "T," and other types; and the third was Alexanderson's multiple antennae. Prof. Tykociner has been engaged in research at Illinois about two years. For about 14 years previous to this time he was one of the foremost experts of Russia.

Mechanical Engineering News

DEPARTMENT NOTES

Gear investigation. Professor C. W. Hamm and J. W. Huckert of the mechanical engineering department, are conducting an investigation on the efficiency and wearing qualities of gear teeth. The work is being done in the research laboratory of the department. The machine used in carrying on the investigation is the Lewis Gear Testing Machine, a special machine designed and built for the University of Illinois by the Wilford Lewis Company of Philadelphia.

In preparation for the investigation, a considerable amount of time was spent in designing and building an indicating gage for measuring tooth wear, since there is no similar machine on the market. Professor Hamm has interested three of the leading manufacturers of gears and gear cutting machinery in the investigation, to the extent that they are now supplying the material used in the experiments. Preparations for the work are well under way and a few preliminary tests have already been made. The data obtained from this investigation will be of great interest to manufacturers and users of gears.

Terry Steam Turbine. A new Terry Steam Turbine was recently installed in the power laboratory to be used in determining the most economical consumption of steam for a required load. The turbine is made up of a double Curtiss wheel and six Rateau wheels. The turbine runs at an inlet steam pressure of 145 lb per sq. in., and with a speed of 3,565 r.p.m. It has six high pressure nozzles delivering steam from a nozzle ring. Two of these nozzles have no valves so it is impossible to shut them off. The valves on the remaining nozzles, however, make it possible to run the turbine with any combination of nozzles open under a 1-4, 1-2, 3-4 or full load. From curves obtained from the test data, it is possible to determine the least number of nozzles required to deliver the desired load. The turbine runs a 250 volt generator which delivers 400 amperes at full load.

Otto Gas Engine. A new 50 h.p. Otto Gas Engine has been added to the equipment of the power laboratory. The motor which has a base of 12 inches and a stroke of 21 inches, runs at a speed of 230 r.p.m. City gas used as a fuel, passes through a gas meter which measures the amount of gas used and the pressure of the gas during the test. Ignition is furnished by a high tension magnet, with a make and break circuit. The engine is started with compressed air and is run a sufficient length of time to overcome the inertia of the motor parts. Junior students in the mechanical engineering department are required to find the maximum efficiency of the engine.

The National Warm Air Heating and Ventilating Association has appropriated the sum of $25,000 to be used in heating and ventilating experi-

ments and research work at the University of Illinois. The money will be used in buying a lot, erecting a modern eight room house, and in purchasing the necessary equipment for the new building. The building and equipment will be used in determining the efficiency and the capacity, together with the proper condition and operation of the furnace to do the work required.

Machine Shop. The foundry division of the mechanical engineering department has recently purchased a new electric drying oven with an automatic temperature control. The inside dimensions of the oven are 10 inches by 12 inches by 10 inches. Power is supplied from a 110 volt alternating current line. The oven was purchased from E. H. Sargent and Company, Chicago.

Faculty Notes. John H. Parker, '20, is acting as full time assistant in the mechanical engineering laboratory.

J. R. Taylor is a full time instructor in mechanical engineering design. Mr. Taylor received the degree of bachelor of science from Purdue University in 1922.

J. W. Huckert, who has been engaged as research assistant in the mechanical engineering laboratory, holds the degree of bachelor of science from the University of South Dakota. Mr. Huckert succeeds J. E. Nicholas, who recently resigned.

John A. Ganff has been promoted from assistant to instructor.

A. S. M. E.

The American Society of Mechanical Engineers and the Railway Club held a joint meeting in Engineering Hall at 4 o'clock, December 14, 1923. A lecture, illustrated with moving pictures, was given by Mr. Walker H. Evans of the Baldwin Locomotive Works. The methods of assembly from the chassis to the completed locomotive were shown in the picture. The lecture was highly instructive from the engineering standpoint. About 100 men attended the meeting.

Pi Tau Sigma

Pi Tau Sigma, honorary mechanical engineering fraternity, held a formal initiation followed by a banquet at the Inman Hotel, December 12, 1923. After the banquet short talks were given by both faculty members and students. T. C. With, '24, president of the organization, gave an address of welcome to the new members. J. R. Scott, '24, acted as toastmaster. The following men were initiated: F. L. Peterson, '24, J. L. Schaller, '24, C. S. Strike, '24, B. A. Conlin '24, C. R. Murray, '24, J. R. Ganff, '24, R. E. Peterson, '25, W. S. Roesch, '25, G. B. Rich, '25, and C. F. Hinnes, '25.

Railway News

Mr. R. F. Mitchell who has for some years past been research assistant in the railway engineering department is leaving this year. Mr. Mitchell intends to take up steel work at Birmingham, Ala. It is not definitely known at the present time whether someone will be put in his place at the University or not.

The railway electrical courses are in the process of change this year. The senior schedule only is involved, it being the plan of the department to introduce E. E. 35, 85 36, and 86 and cut out E. E. 55. Some of the E. E. courses must be shortened to permit the change. Several of this year's seniors have made the substitution to advantage, and it has been felt that the permanent change in curriculum should also be advantageous.

The new General Electric PC 5 controller and the two motors are completely installed now and were exhibited for the first time at the engineering open house. The apparatus has been placed in an extension built to the brake shoe testing plant. The railway labatory now extends over considerable area, and is one of the most complete in the country.

The railway Club obtained and exhibited the film made in the plant of the Baldwin Locomotive Works with much success. The picture was very complete taking up the phases of locomotive construction and assembly. The picture proved of interest to many persons other than railway students. Election of officers for the folowing semester will take place January 10, 1924.

Mining Engineering News

Department Notes

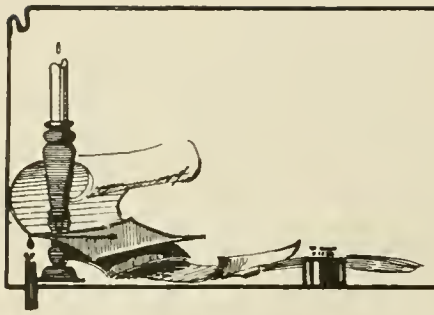
Several new pieces of machinery are being installed in the Mining Lab.

The Cyclone Dust Collector is designed to collect the dust from the various other machines in the lab. and conduct it to the outside. A specially operated electric fan blows the dust laden air into a funnel-shaped device, causing a swirling motion. The particles of dust are driven against the side of the funnel and fall to the bottom, while the air goes out the top. The fan is unique, in that it sucks the dust from the machinery, and also blows it to the outside.

The Hummer Jig, recently installed, is a new innovation in jig screening. A 15 cycle, 1 K.V.A. generator excites the electromagnet to give the screens the vibration to separate the various sizes of rock, into three grades.

Work is also being done towards perfecting a new air jig, which will separate various grades of

(Continued on Page 100)



ALUMNI NOTES

The civil engineering seniors had a wonderful opportunity to meet some of the alumni at the banquet in Chicago during the inspection trip. Among those present were: *Prof. W. A. Knapp*, c.e., '07, of Purdue. *A. J. Schafmayer*, c.e., '03, Division Engineer, city of Chicago. *J. T. Hanley*, c.e., '10, of the Corrugated Bar Co., *Merle J. Trees*, c.e., '07, vice-president of the Chicago Bridge and Iron Works, *O. E. Strehlow*, c.e., '96, *C. S. Pillsbury*, c.e., '07, and *C. H. Mottier*, c.e., '10, office engineer of the Illinois Central.

Murray Hanes, a.e., '13, is an architect in his father's office in Springfield.

George E. McIntyre, a.e., '13, is a structural engineer for the Kansas City School board.

C. R. Velzy, m.e., '14, is living in Urbana and is an engineer for the Champaign-Urbana Drainage District.

W. S. Slack, e.e., '18, is selling electrical trucks for the General Electric Co., in Chile, S. A.

H. H. Herbert, e.e., '23, is a masonry inspector for the Illinois Central as is *E. C. Kuehl*, c.e., '23.

R. H. Whipple, c.e., '06, is assistant chief engineer of the American Gas Co., of Philadelphia.

Stanley P. Farwell, e.e., '07, is vice-president and director of the Bureau of Commercial Economics in Chicago. In this capacity he is serving the industrial engineering department of the Insull utility companies. At one time he was an instructor at Illinois.

R. F. Lehmen, e.e., '10, is connected with the Ampere factory of the Edison Lamp Works, in New Jersey.

R. S. Gregg, a.e., '13, has been appointed as assistant to the supervising architect of the University. He was formerly with Hewitt and Emerson of Peoria, as an architect.

H. H. Hudsall, c.e., '97, is general superintendent of the Leonard Construciton Co., of Chicago. He has in his employ *Carson Jennings*, e.e., '16.

F. S. Gurda, a.e., '20, is in Milwaukee as the junior member of Gurda and Gurda, Architects.

Charles D. Vail, e.e., '91, has been appointed manager of parks and safety for the city of Denver. After graduating, he worked for the Union Pacific and Oregon Short Line on surveys, shop construction, division control and railway construction, later he served as assistant engineer of the city water department of Butte, Mont. At present he is a railway and hydraulic engineer for the Colorado state public utilities commission.

C. L. Conrad, e.e., '22, has been transferred to the Lighting Commercial Department of the General Electric Co., after having completed his Students' Training Course.

F. S. Carter, e.e., '22, who has been connected with the Industrial Department of General Electric has been transferred to the field sales force at the Chicago Office.

W. A. Mann, J. W. Marquardt, R. V. Kay, e.e.'s, '23, are now enrolled in General Electric's Training Course.

Charles L. Morgan, arch., '14, is responsible for the Homecoming Posters illustrating the Stadium. These posters found their way to almost all of the towns and cities in the middle west.

P. T. Walton, e.e., '94, is with the Illinois Steel Bridge Co., at Jacksonville. He has had varied experiences since leaving school, among them being: Mississippi River surveys, bridge work at St. Louis, Engineer and Agent for the Illinois Steel Bridge Co.

S. B. Flagg, m.e., '04, is consulting engineer to a firm of stoker manufacturers. His headquarters are in New York City.

C. C. Wiley, e.e., '04, of our Department of Highway Engineering had charge during the summer of the same department at Iowa State College at Ames.

H. H. Dunn, e.e., '08, formerly associate in railway engineering at the University, is now with John Biehler and Co., as a consulting electrical engineer.

W. R. Mueller, a.e., '20, is also in Milwaukee with the Griscom-Russell Co., manufacturers of machinery.

Rodney Spangley, a.e., '21, has also come back to the campus to work in the supervising architect's office.

Bently Brown, m.e., '22, is in the test department of the Santa Fe at Topeka.

A. H. Fessler, cer.e., '23, has been appointed superintendent of the Hamilton Clay Manufacturing Co., of Carthage.

Alberta Raffl, a.e., '23, is now with Talmadge and Watson, architects, of Chicago. Miss Raffl is one of four women who have graduated as engineers.

R. W. Morton, m.e., '23, is in Urbana as an engineer for the Leavitt Manufacturing Co.

George H. Wilmarth, e.e., '09, is vice-president and general manager of the Minnesota-Wisconsin Light and Power Co., with headquarters in Eau Claire. His company supplies electricity to 73 cities and the plant controls 71,800 H. P. of developed water power.

Charles B. McGrew, arch., '13, has been wandering around Italy picking up interesting bits of architectural ideas.

Floyd W. Ray, arch., '21, has just returned from England where he studied under the Plym Fellowship. *E. L. Hubbell*, arch., '22, has recently sailed as the winner of the tenth award of the Fellowship.

O. E. Brunkow, arch., '22, is an architectural designer for D. H. Burnham and Co., of Chicago.

F. C. Feutz, c.e., '14, is the district engineer for the Illinois State Highway Department with offices Paris, Ill.

E. J. Mehren, c.e., '06, is not only a successful editor but also seems to be somewhat of a long distance speaker. Through the courtesy of Station WJZ, of the Radio Corporation of America, Mr. Mehren has recently broadcasted a talk on the engineering profession.

From the Armour Engineer, we find that *Henry Penn*, c.e., '10, has been appointed Assistant Professor of Civil Engineering and baseball coach. The *Engineer* says, "Coach Penn has had considerable experience in college and semi-pro circles. He graduated from Illinois and while there made a remarkable record as a pitcher. —he should be a valuable addition to our coaching staff."

C. B. Styles, c.e., '12, is president of the Styles Contracting Corporation, Chicago, builders of railroad and industrial bridges and buildings.

A. M. Breune, m.e., '21, is doing general engineering work, turning out draft gears, hand brakes, buffers, shock absorbers and car door fasteners.

Warren E. Cleveland, m.e., '21, is teaching applied mathematics and mechanical drawing in the Arsenal Technical High School of Indianapolis.

Martin Frish, m.e., '21, is doing research and development work for the Combustion Engineering Corporation, Milwaukee.

A. M. Grasse, m.e., '21, is with the Goodman Manufacturing Co., of Chicago. His particular work lies in the development of a coal loader to be used in mines.

H. A. Gulley, m.e., '21, is with the Texas Co., specializing in the construction of power plants.

Arthur Houser, m.e., '21, is in the Product Engineering Department of the Crane Co., Chicago.

G. A. Lofquist, m.e., '21, works with the Hayward Co., contractors, engineers and manufacturers. He is in the ventilating department.

E. G. Stanley, m.e., '21, is specializing in refrigeration for the Henry W. Vogt Machine Co., of Louisville, Ky.

Oscar F. Stauder, m.e., '21, is with Westerlin and Campbell, Chicago refrigeration engineers and contractors.

R. R. Mills, c.e., '23, is with the Manitowoc Portland Cement Co., in Wisconsin. The firm is putting up a new $75,000 cement plant and Bob was responsible for the design of all the concrete in the place.

O. E. Way, a.e., '23, also journeyed to Manitowoc and was for a while with the cement plant but later went with the Manitowoc Ship Building Co. Here he designed the steel work and is supervising the erection of the new cement plant.

J. G. Worker, m.e., '04, has been appointed assistant to the President of the American Engineering Co., at Philadelphia.

J. M. Bond, m.e., '05, is a mechanical engineer for the Hope Manufacturing Co., of Stockton, Calif.

Alfred Rehnquist, c.e., '22, is testing cement for the State Highway Department at Oglesby.

M. Cooper, m.e., '22, is with the Johnson Service Co., of Milwaukee. While on the campus at Homecoming he was run down by an automobile and had to spend a few days in the hospital.

Paul Witte, m.e., '23, is with the Henry Vogt Machine Co., of Louisville as Advertising Manager.

E. T. Blix, c.e., '21, has gone to the Kansas City office of the Mississippi Structural Steel Co., as a salesman. He was formerly connected with the Decatur office.

H. R. Borland, cer.e., '23, is making brick in Peoria.

C. E. De Leuw, c.e., '12, is a member of the firm of Ketker, De Leuw & Co., consulting engineers of Chicago. He is now doing municipal improvements around Chicago.

Lewis Fisher, c.e., '12, is a member of the firm of Cope and Fisher of Decatur. He built the dam across the Sangamon at Decatur and is now working on a filter plant for the city.

Paul Kircher, c.e., '12, manages the pole division of the Massey Concrete Products Co., of Chicago.

Dave Murphy, c.e., '12, has also deserted engineering for athletics. His office is in the U. of I. Gym.

H. F. Wagner, c.e., '12, is with the Illinois Traction Co., at Peoria.

Ned Warren, c.e., '12, is manager of the Chicago office of the Portland Cement Association.

R. W. Ibenfeldt, m.e., '21, is with W. H. Miner, inventor and designer of railway appliances.

E. H. Allison, min.e., '22, is in consulting engineering work as the head of the Allison Engineering Company of Chicago.

E. V. Allen, min.e., '16, is the general manager of the Gengol Plant of the Illinois Steel Company, Chicago.

P. B. Buckey, min.e., '22, is a member of the firm of Buckey Coal Company of Chicago with headquarters in that city.

C. W. Campell, min.e., '17, is employed as a mining engineer by the Old Ben Coal Corporation at West Frankfort, Illinois.

F. A. Doucer, min.e., '22, is taking the student course of the Ingersoll-Rand Machinery company at Chicago.

H. C. Eckart, min.e., '22, is superintendent of operations at his company's iron mine at Coleraine, Minn.

J. C. Fitzpatrick, min.e., '17, is in insurance work with the Associated Companies at Hartford, Connecticut.

Thomas Fraser, min.e., '17, is Research Assistant Professor of Mining Engineering at the University of Illinois. Professor Fraser was formerly in the U. S. Bureau of Mines as Mining Engineer.

J. H. Griffner, min.e., '15, is in the compensation department of the Associated Companies at Hartford, Connecticut.

R. M. Heinrichs, min.e., '22, is taking the student course of the Goodman Manufacturing Company at Chicago.

J. S. Housman, min.e., '14, is in the head loading department of the Goodman Manufacturing Company, Chicago.

J. C. Happeney, g.e., '25, has gone into printing business for himself in Chicago.

Engineering Open House

(Continued from Page 76)

dents. All the work of the wood shop, foundry and machine shop was centered on the production of this engine. The work in these divisions was handled with the skill and efficiency of an A-1 manufacturing concern. In collaboration with the production of the engine the studies being made by these divisions on molding sand, the miscropic investigation of metals, forging and Thermit welding were demonstrated.

Over in the Electrical Engineering lab the operation of telephones, sign flashers and innumerable lights served as an introduction and appetizer to the big event next spring—the E. E. Show. W. R. M., the University broadcasting station, was open for business and programs from all parts of the country were being enjoyed.

The last lap of the journey took the visitors into the domain of the technical work again. The investigation of the fatigue of metals, and the work in the strength of materials and hydraulics was displayed by the department of theoretical and applied mechanics.

The organization of such an exhibition as the engineers staged required a large amount of work by everyone and the committee in charge of the Open House deserves a great deal of credit for the excellent manner in which the work was handled. Prof. E. C. Schmidt, head of the department of railway engineering, was general chairman in charge of the Open House. He was assisted by faculty representatives of each department and a student committee consisting of I. E. Boberg '24, chairman; W. F. Gerdes, '24, G. G. Robinson, '24, and J. R. Scott, '24.

Department Notes

(Continued from Page 97)

material by the use of air pressure. The material will be placed on a porous cement plate through which air will be forced, and by regulating the flow of air, different degrees of separation may be obtained.

Thomas Fraser and L. A. Moses are doing research work in the Mining Lab. on the problem of mine ventilation. They expect to arrive at results which will be of practical value to the mining world, and if they succeed, theirs will be the honor of the first practical solution to this problem. There are at present a number of well-known principles and formulae which are theoretically true, but which

fail when put into actual practice. Mining men have been reluctant to admit this for a number of years, and until a very few years ago, little was done in this line. The theoretical results which Fraser and Moses derive from their work here will be tested out in actual practice in several mines, to which they have access. In this way they expect to finally arrive at conclusive practical results which, when published, will be but one more contribution by the University of Illinois to the mining world.

Mining Society Notes

On November 21 an open meeting of the Mining Society was held in 221 Engineering Hall, and an exceptionally large number of guests were present. L. B. Rice, of Hunt and Company, consulting engineers, Chicago, was the speaker of the evening, and as the meeting was an open one no business was taken up. Mr. Rice addressed the society on the subject of "Metal Mines In Canada," and illustrated his talk with slides and three reels of motion pictures. His lecture concluded with an interesting discussion of the Canadian Mining Laws, relative to prospecting and the exploitation of mines. These laws are very favorable for the development of new mineral resources, as the Canadian Government is anxious to interest American capital and American engineers. The meeting adjourned at 8:30.

Delta Mu Epsilon Initiation

On Sunday, December 8th, Delta Mu Epsilon, honorary mining fraternity, held its regular fall initiation. A professional atmosphere was given to the entire ceremony by holding it in one of the mines near Danville. Nine new members were successfully initiated.

Formal initiation was held Monday evening, December 9, after which the regular banquet was held for the old and new members.

The Urbana-Champaign Sewage Treatment Plant

(Continued from Page 73)

structed as a flat slab, 5 in. thick, and the ridges poured afterward. These ridges were placed at 12 in. centers with a 4 in. crest, an 8 in. base and 3 in. high. The sewage will flow from the valleys, thus formed, into the main drains in the pipe gallery, which lead to the lagoons or to the secondary tanks, as the case may be.

The Pumping Station. The building, known as the pumping station, will house, in addition to the pumps and their motors, a chemical and bacteriological laboratory, a garage, an air compressor, storage space for an industrial locomotive and a small machine shop.

For raising the sewage from the wet well to the dosing tanks, three centrifugal pumps will be installed capable of pumping 2, 3 1-2, and 5 million gallons per day, respectively. They will be direct-connected to vertical, slow speed motors, set on the floor above and automatically controlled by means of floats in the wet well.

For operating the sludge air lift, there will be installed a single stage, belt driven air compressor, manufactured by the Sullivan Machinery Company. The air lift equipment will be capable of lifting the sludge, at the rate 1,000 g.p.m. through a maximum lift of 15.75 ft.

The entire substructure, consisting of the wet well, the pump well, a basement under the machine shop, and a foundation wall and footing under the remainder of the building, will be constructed of reinforced concrete.

The superstructure will be constructed of common, red brick, laid in regular bond, with every sixth course a full header. The roof over the laboratory will be covered with 1 in. sheathing and asphalt shingles. The flat roof over the garage will be covered with reinforced gypsum slabs, tarred felt, pitch and gravel.

The work is being carried on under the supervision of the Urbana-Champaign Sanitary District, organized as a corporation under the laws of the State of Illinois, with the power to levy taxes upon the property within its limits. Pearse, Greely and Hansen, Chicago, are the engineers in charge of plans, specifications and general supervision of construction. English Brothers, Champaign, were awarded the contract and are carrying on the construction.

Activities in College

(Continued from Page 85)

which would weld the engineers together into a live active body. This year there is every prospect of seeing such an event made a reality; the faculty and a group of students have made preliminary arrangements for the day and everything seems to indicate that if the students in the college will actively support the plans, the Engineers' Day will be made an event that will be well worth while.

Everything attempted depends for its success on the support of the students. If everyone will give a little of his time and display a little interest in the proposed events, this year will see activities firmly established that will make for better and more active engineers both before and after graduation.

Power Data for Illinois Coal Mining

(Continued from Page 75)

per cent pumping from nil to 52.2 per cent; cutting (mining) from nil, in a 'hand' mine, to 47.2 per cent and haulage from 4.0 per cent to 67.1 per cent.

A futile effort was made to discover a rough-and-ready formula for the amount of power required by a mine of a given capacity. The data proved that costs per ton do not vary as depth, nor as daily tonnage. If depth possesses a definite function in any of the items of power consumption, it certainly must show in the item of hoisting; yet the percentage of a mine's total power consumption that is required for hoisting is often less for a deep mine capacity lessons the cost of each step in the production but of less depth.

Normally, in industrial lines, an increase in capaciey lessens the cost of each step in the production per unit. In coal mining the unit of production is one ton of coal. For a period of one year one mine averaged 2635 tons per day at a power cost per ton of 4.402c while a neighboring, commonly-owned mine produced 3500 tons at a power cost per ton of 8.154c. In other words, the tonnages were as 1 to 1.328 while the relative power costs were as 1 to 1.825—the variations being in the same direction, quite contrary to usual practice. Curiously, also the bigger and more costly mine was 54 feet less deep than the other mine. In this particular comparison the incongruity is occasioned by an abnormal demand for power by haulage in the shallow mine, this item being $125.55 per day as against $11.80 per day in the smaller mine.

Disproportions of this and other sorts appear promiscuously among the power data.

It is an interesting fact that the average daily cost of power is less at mines which use purchased electricity exclusively than at mines which use home-made or so-called 'generated' electricity. These respective costs per ton are 6.0 cents and 7.7 cents for groups of mines of approximately 3000 tons daily production per mine. The economy in using purchased power shows not only in activities that are comparatively constant, as in driving fans, but in such intermittent work as pumping which usually is conducted during fractions of full working time. These respective costs in cents per ton are:

	Ventilation	Drainage
Generated power	1.982	0.638
Purchased power	1.208	0.166

To persons who have not carefully investigated this subject it is paradexical that a coal-mining company can sell coal for fuel to a power company and at the same time advantageously consume the power company's electricity. It would seem that the coal company itself could generate electric power at its minimum cost considering steam-plant practice only. The fact remains, however, that the public-utility company can usually pay freight on the coal, stand losses of power in transmission, make a profit and still supply power to the mine operator more cheaply than he can generate it himself. This statement is especially true regarding mines of less than 3000 tons daily capacity and is explained in the advantage possessed by the power company in its larger plant with its superior equipment that includes the latest refinments regardless of initial cost.

In Illinois this paradox is partially explained also in the usual scarcity about mines of suitable water for the condensation of the exhaust steam from engines or turbines. Power companies select their plant-sites with full consideration of such requirements.

Illinois has more than 6500 miles of electric transmission line handling current at 33,000 volts, 3-phase and 60 cycle. Government statistics state that this power is generated by the burning of only 2.59 lbs. of coal per kilowatt-hour. With coal costing $3.00 per ton at the power plant, this means that a kilowatt-hour of electricity is generated in this state at an average fuel cost of 0.39 cents—an accomplishment indeed.

Schedules for public power service are complex, always involving two classes of charges—primary and secondary—and these are often on sliding scales. In a general way they provide power at a decreasing price per kilowatt-hour as monthly consumption increases. Intricate calculation may be required in some cases but the cost of power per kilowatt drops from 4.68 cents upon a minimum monthly consumption of 1000 kilowatt-hours to 2.34 cents when the monthly consumption is 500,000 kilowatt-hours.

A completely-electrified mine with an average daily coal consumption of around 3000 tons might consume about 150,000 kilowatt-hours which would cost 2.06 cents to 2.80 cents per kilowatt-hour (different schedules) but would probably average 2.42 cents. It is obvious that, with such business conditions as these, the power company has a big margin to cover its operating and overhead expenses and its profit. The coal operator who buys his power takes into consideration the profit he makes from selling coal that he would otherwise consume under his boilers as this pays a significant part of

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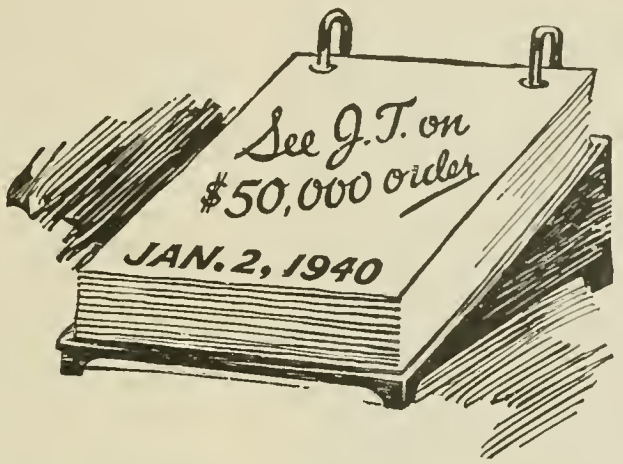

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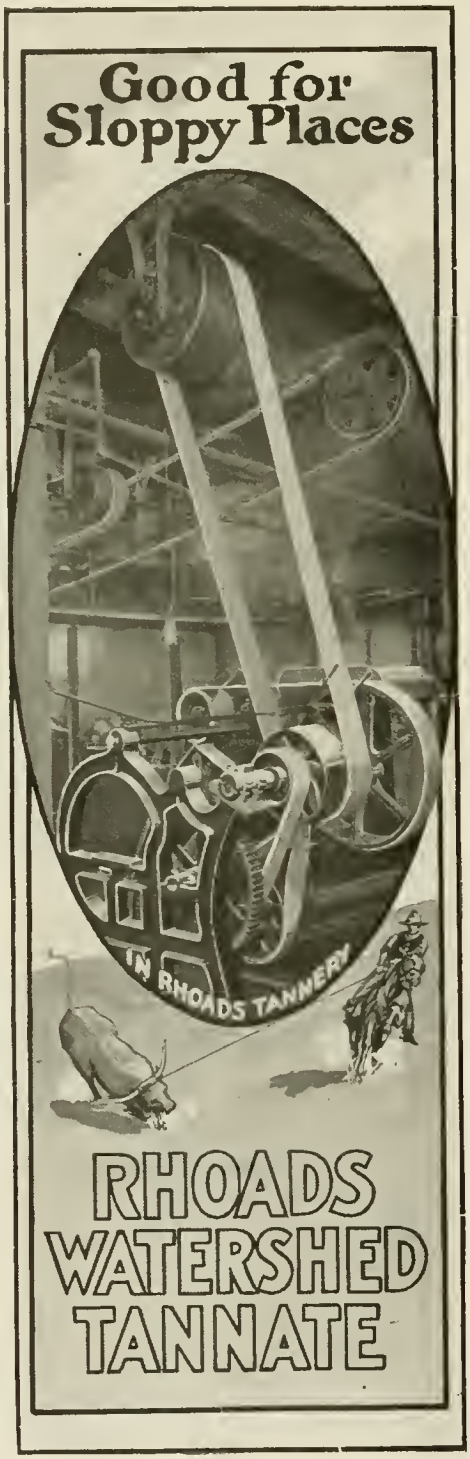

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(Continued from Page 102)

his power bill.

Electricity is fast replacing steam for every power-consuming activity in coal mining. This modern practice has greatly simplified mining equipments and layouts but these are still somewhat complicated for the reason that both direct-current and alternating-current apparatuses are used in every electrically-equipped coal mine. Alternating current is reasonably preferred and it is therefore used whenever possible. This form of power drives coal-cutters of all sorts, fans (main and booster), pumps (main and gathering), shop machinery, tipple machinery, and hoisting engines; but direct current is universally used in electric haulage. This would not be so without good reason.

There have been many serious efforts at alternating-current haulage in coal mines but practice, in every case, has reverted to the use of the other sort of electric current. Direct current is consumed by two general types of locomotives—trolley and storage-battery. Trolley locomotives have been used most commonly but battery locomotives are being adopted in increasing numbers. Many mines use both types and thus have a further complication of electrical equipment.

The inefficiency of alternating current in haulage rests in many technical objections. Some of these reflect from the restriction placed upon the size of a locomotive by the underground conditions. It is the prediction of electrical-machinery engineers that mines must always use direct-current for locomotives. To overcome heavy losses in transmitting such current the long distances necessary underground and, at the same time, to comply with a state law prohibiting the usage of any voltage above 275, modern practice is to carry high-tension, alternating current over the surface of the coal property and down through drill holes that tap transformer stations in the mine. From these sealed stations the direct current is fed to the trolley systems or to the battery chargers.

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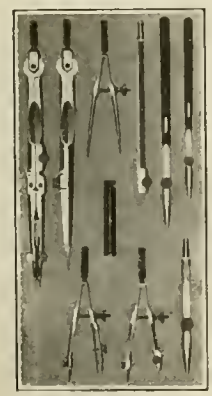

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Developments in Railway Electrification

(Continued from Page 63)

sible with steam engines of equal power rating.

In the shipping of cattle electric smoothness of train operation is not only merciful to the cattle but lessens actual injuries, all too common under steam traction. The shipment of explosives becomes far less dangerous, and minor damages to freight cars and their contents are nearly eliminated by electric operation. In the case of the St. Clair River tunnel of the Grand Trunk system the electric operation of heavy freight trains resulted in the elimination of the breaking of drawbars at the bottom of the tunnel, where the grade changes rather abruptly from descending to ascending. This result was not predicted in this case, and the series of delays and accidents occuring with the previous steam operation of the tunnel was luckily ended.

It is difficult to realize that the efficiency of the very round-about power application of electricity to traction through a steam turbine, its generator, step-up transformers a long transmission line, more transformers, and perhaps a converter, a distribution system and electric motors, can exceed so greatly as it does the efficiency of the direct application of the power of steam from a cylinder only through connecting rods and a crank to the driving wheels of the locomotive. Not only is the thermal efficiency of the power house boilers and steam turbines very high, but the losses involved in the several intervening elements are so small that combined, they do not greatly reduce the economics of the big power station. The output of the electric generating station is usually less than 50 per cent of the power rating of all the active electric locomotives served by it. When an electric train is coasting or standing its locomotive is drawing absolutely no current, while the steam locomotive is burning coal probably at half a full-load rate. When operating under half load the electric motor is taking about 55 per cent of full-load current, while the steam locomotive is burning about 75 per cent of full-load coal. Steam locomotives haul their own coal and water, displacing an equal weight of renumerative freight, burn coal for an hour before starting, and for at least half an hour after ending a run, items entirely absent with electricity. Other minor power items saved under electric traction are the pumping of water into tanks, the supplying of hot water to boilers, the power required to operate coal pockets and turntables and the coal required to keep roundhouses warm enough to prevent freezing in winter. An electric motor is most efficient at its lowest

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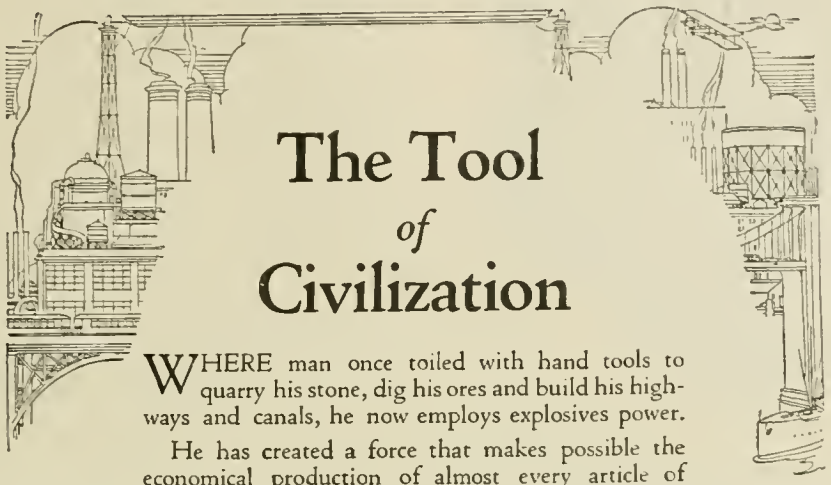

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He has created a force that makes possible the economical production of almost every article of commerce, a power that he can completely control.

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(Continued from Page 106)

temperature, also a transmission line and transformers, while a steam boiler in winter exposed to the inclement weather requires additional coal.

The ability of an electric locomotive to keep in continuous service obviates the expense of changing engines at division points, and makes it possible for 40 electric locomotives to perform all the service rendered by 100 steam locomotives. On this basis the first cost of electric locomotives is no greater than that of steam engines displaced, in spite of their very much higher price individually. Electric repairs are also merely nominal as compared with steam boilers and engines having reciprocating and hence unbalanced stresses.

Aside from the many operating advantages of electricity the gain in real estate values with electrification may prove important. The New York Central R. R. has been able to rent large hotels, office buildings and warehouses built over its trackage north of the Grand Central Terminal at New York, producing a very large income not possible had steam operation been retained. The removal of coal yards and pockets, of water tanks and pumps, of turntables and of smoking roundhouses frees much land for sale or other profitable use, the returns from which may go far toward meeting the cost of electrification in any district where land is valuable. Under the quiet of electric traction, land in the immediate vicinity of the railway increases in value, especially in residential districts.

Coal burning locomotives have set so many forest fires that it is customary to provide and clear a wide right-of-way through wooded country. No such precaution is required with electricity. Also roof fires are often attributable to sparks from steam locomotives. No question of smoke abatement will cause troublesome interviews with city authorities if electricity is the power.

When the time arrives for the electrical equipment of individual cars both passenger and freight, instead of the use of electric locomotives now demanded to permit the continued operation of present-day rolling stock, there will be no power limit to the length of the train. With multiple unit control, under which any car may be the head of the train it is conceivable that a train for local freight business could be made up of separate cars for individual stations arranged in their order, and that as each station was approached the forward car could be detached and driven ahead of the main train delivered on a siding, its motorman immediately picking up a waiting loaded car at that station and running it so as to gain the rear of the passing freight train, which thus would not have to be

(Continued on Page 110)

SHOP LIGHTING.

In an address delivered before the members of the Western Pennsylvania Division of the National Safety Council, Pittsburg, Pa., March, 1918, by C. W. Price, the importance of good lighting in industrial establishments was discussed, and the disadvantages of poor lighting were clearly shown by some figures mentioned by Mr. Price.

A large insurance company analyzed 91,000 accident reports, for the purpose of discovering the causes of these mishaps. It was found that 10 % was directly traceable to inadequate lighting and in 13.8% the same cause was a contributory factor. The British Government in a report of the investigation of causes of accidents determined a close parallel to the findings of the insurance company above quoted. The British investigators found that by comparing the four winter months with the four summer months, there were 39.5% more men injured by stumbling and falling in winter than in summer.

Mr. John Calder, a pioneer in safety work, made an investigation of accident statistics covering 80,000 industrial plants. His analysis covered 700 accidental deaths, and of these 45% more occurred during the four winter months than during the four summer months.

Mr. C. L. Eschleman, in a paper published in the proceedings of the American Institute of Electrical Engineers several years ago, reported the result of an investigation of a large number of plants in which efficient lighting had been installed. He found that in such plants as steel mills, where the work is of a coarse nature, efficient lighting increased the total output 2 %; in plants, such as textile mills and shoe factories, the output was increased 10%.

In an investigation of the causes of eye fatigue, made by the Industrial Commission of Wisconsin, it was found that in a large percentage of industries, such as shoe, clothing and textile factories, the lack of proper lighting (both natural and artificial) resulted in eye fatigue and loss of efficiency. At one knitting mill, where a girl was doing close work under improper lighting conditions, her efficiency dropped 50% every day during the hours from 2:30 to 5:30 P. M.

The above mentioned incidents indicate how important a factor lighting is in the operation of the industrial plant. It has been well said, "Light is a tool, which increases the efficiency of every tool in the plant." Glare or too much light is as harmful as not enough lighting, and in no case should the eyes of the workers be exposed to direct rays, either of sun or electric light.

Windows and reflectors should always be kept clean; that is, cleaning them at least once a week, for where dust and dirt are allowed to collect, efficiency of the light is decreased as much as 25%.

Good lighting, in addition to its other marked advantages, is a strong incentive towards keeping working places clean, for it clearly exposes any place where dirt or other material has been allowed to collect. White walls and clean windows glazed with Factrolite Glass will eliminate the sun glare and increase the illumination 25 to 50 feet from the window from 38% to 72% as compared with plain glass.

Lighting is of primary importance to every employer and fully warrants a careful investigation of the subject, for there is no substitute for good lighting, and if it is not supplied the efficiency of the entire working force must suffer a serious reduction.

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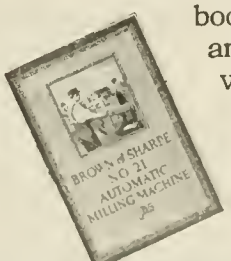

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(Continued from Page 108)

stopped at all during the entire run. The train on arrival at its destination might be a completely different train so far as individual cars is concerned, but carrying the same crew. By some such scheme much time could be saved, a heavy train would not have to be stopped to deliver a few packages of freight, and sidetracking would be greatly reduced. With individual electrical equipment for local frieght cars the necessity for switching engines will almost cease.

The purpose of this article is not to predict the precise direction in which electrification will progress, but to show a number of unexpected angles of the problem in order to give the railway engineer a better viewpoint when the question of changing to electricity is considered. It has been proved that electrification brings many benefits besides those commonly recognized.—conservation of fuel, freedom from smoke, and safety in operation. When all the advantages sure to accrue from electrification are clearly presented to the capitalists interested in a steam railroad property they should not find the first cost an insuperable objection.

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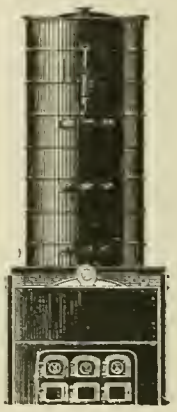

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March
1924

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THE TECHNOGRAPH

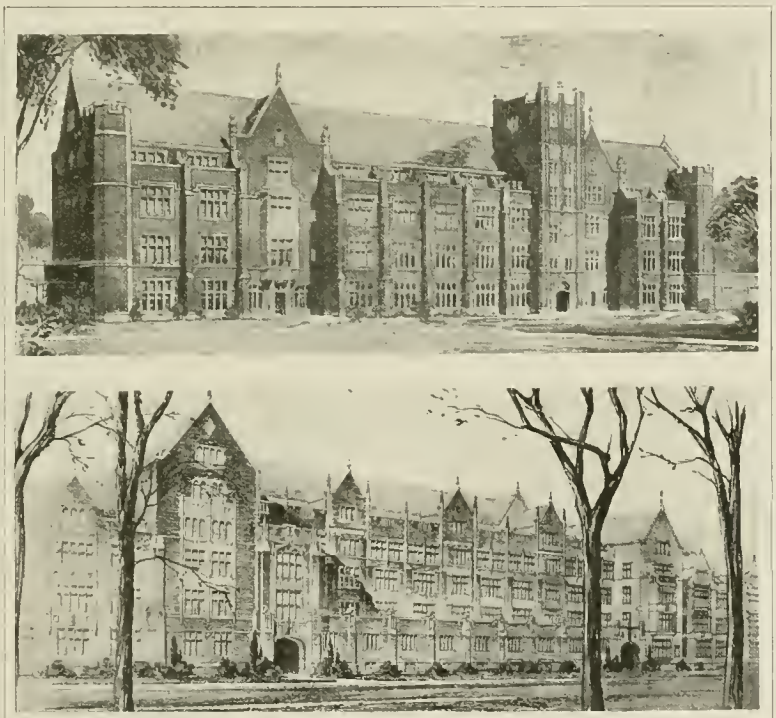
Published Quarterly by the Students of the College of Engineering—University of Illinois

VOL. XXXVI MARCH, 1924 NUMBER III

New Buildings for the University of Illinois

J. Robert Welsh, c.e., '24

A donation of funds by the alumni and students for a new stadium, and another by Senator W. B. McKinley for a new hospital, along with the appropriations made by the last legislature for eight new buildings have made a building era for the University that is probably the greatest in its history. This winter has witnessed the completion of a new Agricultural Building, and fall will find the Stadium, the new Clinical Building and the new Research Laboratory and Library ready for occupancy. The two latter buildings are located in Chicago. Within the next year, or at most fifteen months, six other buildings will be completed on the campus. The total cost of the structures will be about five million dollars. The accompanying map of the south end of the campus shows the location of the new buildings, and the architect's drawings show how they will appear when completed. All of the buildings have been placed so that they will fit in with proposed plans for the complete development of the south campus.



The Clinical Building (above) and the Research Laboratory and Library which are being completed for the College of Medicine in Chicago. They are part of a ten million dollar group that will be built by the State Department of Public Works and the University.

The Agricultural building which was completed this winter and is being occupied this semester for the first time, was built and equipped at a cost of $500,000. Directly west of it, on the other side of Burrill Avenue will be erected the new Commerce Building. The two buildings will be the same size and almost identical in appearance except for a few differences in the entrances. The new Library will be just north of the Commerce Building as shown in the plan. It will be a large structure of brick and stone, of Georgian style of architecture. The architect's perspective shows a front view of it, with the north end of the Commerce Building in the background. To the south of the Armory and at only a short distance from the Stadium, the new Men's Gymnasium will be built. The accompanying view shows it as it will be when completed. The present plan calls for the construction of only the center portion; the two end wings will be added later. The building will be of brick and stone, and provision has been made to equip it completely.

The McKinley Hospital, which is a gift to the University from Senator McKinley, will be built at a cost of $205,000. At present only the center portion will be constructed, but when conditions war-

rant it, the two end wings will be added. It will be located on Lincoln Avenue on a part of the ground that is now the forestry.

Contracts have been let for the construction of the above four buildings, and the work is now under way. Plans for another Woman's Residence Hall to be built on Nevada Street just west of the present Residence Hall, and for the new agricultural service buildings are now being prepared in the office of the Supervising Architect of the University. The Dairy Manufacturing Building is one of the largest of the group of agricultural buildings, and will be located just east of the Stock Pavillion. The cost of the Residence Hall will be $250,000, and the agricultural service buildings $380,000.

A co-operative agreement has been made between the State Department of Public Welfare and the University for the construction of a group of buildings in Chicago which will contain hospitals, a laboratory, a library and a clinical building. Under the agreement the University will have complete control of the group, and will furnish the entire staff. The State Department of Public Works will pay the cost of maintaining and operating the buildings, and will benefit in the agreement in that the hospitals will be open to all. Under the terms agreed upon the University built two new buildings which were dedicated this month. They are the Clinical Building and the Research Laboratory and Library. The cost of these two buildings was $800,000, and the total cost of the completed group will be ten millions of dollars.

The tenth of the new buildings is the Stadium which is being built at a cost of two millions of dollars. It is expected that it will be completed by fall. It is a great structure of steel and concrete trimmed with brick and Bedford limestone, and is a gift to the University from the alumni and students. When completed it will be one of the largest and most beautiful structures of its kind in the world.

While such a large building program is interesting to all, it is of special interest to engineers because of the many architectural and engineering problems connected therewith. Many pages could be written telling of the problems and details that drew heavily upon the designer's ingenuity in securing buildings of maximum service value and good architectural appearance. In addition to these problems there is the necessity of arranging the buildings on the campus so that they will render the greatest and most convenient service. A study of the map of the south end of the campus discloses many changes that will be effected during the coming year.

A new east and west road will be opened up between the Commerce Building and the Library, and

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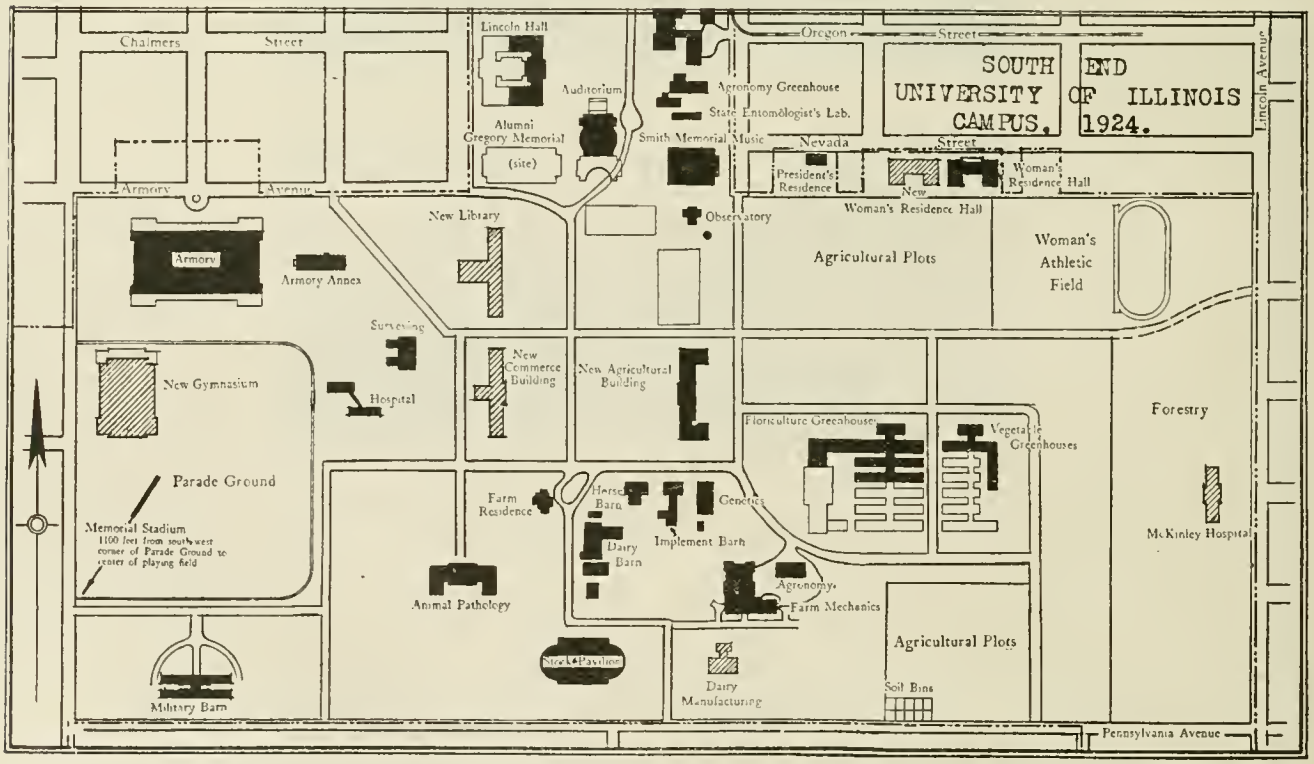


South end, University of Illinois campus. Completed buildings are printed in solid black; those under construction shaded; those planned are outlined. The campus extends for nine blocks north of Chalmers street. Its total area is 393 acres. The area of the farms, which lie south of the campus, is 991 acres.

Vibrations in Buildings

F. R. Watson
Professor of Experimental Physics

One of the problems of modern buildings which is receiving an increasing amount of study is the question of the acoustics. Architects for a considerable time have been concerned about the acoustics of auditoriums, because of the serious defects that usually exist in rooms where no attention has been paid to the acoustic design. Excessive reverberation is the most common fault whereby sound persists too long before dying out so that the words of a speaker, for example, overlap and produce a confusion that makes it difficult for audiences to understand what is said. Another fault is found in the echoes set up by sound reflected from walls, particularly curved walls, that concentrate the reflected waves. The problem of the acoustics of auditoriums, however, may be regarded as solved in its essential features, largely because of the investigations of the late Professor Wallace C. Sabine. Auditoriums may now be designed with certainity of good acoustics, and faulty auditeriums already built are corrected with confidence.

More recently, another large problem in the acoustics of buildings has been attacked, namely, the vibrations in the structure. The actions entering into these vibrations are complex so that the solution of the trouble is much more difficult than the proper adjustment of the acoustics of rooms.

Attention has been directed to the problem of vibrations because of the annoying and harmful effects set up. Not only are occupants of buildings rendered nervous and less efficient by these disturbances, but it is suspected that building structures suffer deterioration under the influence of long continued shaking. Except for severe earthquakes and blasting, the vibrations generated are usually small, and it is therefore rather surprising that any noticeable effects should result from them.

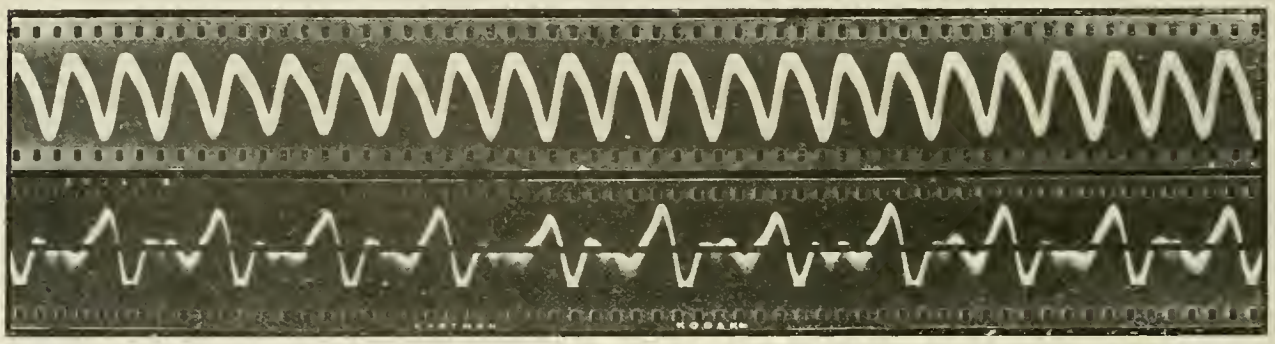
Vibrations are considered from two standpoints, those generated by the disturbances outside of a building that penetrate to the interior, and those that originate inside the building and spread throughout the structure. Outside sources of vibration are found in street traffic,—trucks, street cars, and other vehicles that may strike the surface of the ground with impacts exceeding several times their own weight, and thus generate waves that proceed rapidly through the ground and enter buildings through the foundations. Railroad trains also may create very serious disturbances in structures near the track. Earthquakes and blast explosions set up impulsive, violent vibrations that may be very destructive to buildings. The recent disastrous earthquake in Japan has led engineers to study the problem, particularly by noting the effects of the disturbance, to attempt to explain the failure of certain types of construction and to form conclusions about the action of the ground upon which the buildings were erected. Inside a building, the disturbing elements are found in elevators, unbalanced motors and other machines. Vibrational waves start from these elements and proceed in the solid materials to all parts of the building. Noticeable effects are found when a loose door, window or other member is shaken by the vibrations or when a partition or floor sets up resonant motions in response to the periodic forces.

The solution of the trouble is approached in two ways either by reducing the vibrations at the source or by stopping or controlling them after they are started. Methods are now available for correcting the lack of balance in some machines so that they may run smoothly with little vibration. On the other hand the control of vibrations that are progressing in the earth or in a building structure is largely an unsolved problem. Theoretically what is needed is the interposition in the path of the waves of a discontinuity in the conducting structure. Thus, an air space in masonry is a very effective barrier for vibrations, provided the air space is continuous, without any bridging over the air gap by masonry construction. Practically in buildings, this ideal case does not seem possible of fulfillment. For instance, a floor because of its weight must be supported by some solid structure, and any attempt to stop vibrations of a piano by means of an air space is thus thwarted. A compromise solution is obtained by using an air-filled substance such as hairfelt or flax that has enough rigidity to hold up the floor and yet is not continuous like masonry and lacks the elasticity necessary for the effective propagation of waves. Ceiling and side walls, which are supported by the floor, are capable of such air separation, but they should be of sufficient rigidity to prevent any easy lateral vibration. The insulation of vibrations in a room thus involves a detailed study of the surrounding structure with the installation of air-filled materials and the elimination, as far as possible, of all direct solid connections.

In order to study systematically the problem of vibrations in buildings, the writer has used a port-

able seismometer patterned after the design given by P. G. Nutting[1]. Measurements taken with this instrument reveal the characteristics of the disturbing vibrations and give quantitative measurements of the effects of any corrective devices that may be applied. The action of the instrument is based on the seismograph principle, whereby a lead mass of about six pounds weight, supported on a thin Bakelite membrane, tends to lag behind because of its inertia when the suporting stand is moved. The relative motion of the lead and the support may be made manifest by means of rotating mirrors that vibrate a reflected beam of light. Fig. 1 is a reproduction of a photograph taken in this way. The source of vibrations was a tuning fork and to analyze the resultant vibrations by instruments and photographs, and second, to apply corrective measures of such nature that they will effectively reduce the trouble. It will be necessary to make a special study of the corrective devices in the attempt to secure effective results.

When applying corrective measures to reduce vibrational disturbances, the practical question arises as to how far the motions should be decreased for satisfactory conditions. Information on this point is found in measurements of human susceptibility to vibrations. These show that susceptibility of people does not depend primarily on the amplitude of motion, because if the motion is extremely slow, a person does not notice it. As the



(Above) Photograph of magnified motion of table top due to tuning fork making fifty vibrations per second. (Below) Photograph taken on the second floor of a building showing vibrations set up by a motor generator on the first floor.

which oscillating fifty times a second was pressed against the table top that supported the seismometer, thus setting up minute movements of about three ten-thousandths of an inch. The seismometer magnified the motion about 2000 times. Fig. 2 shows the vibrations on the second floor of a building, due to an unbalanced motor on the floor below. A study of this photograph reveals the fact that the vibrations occur thirty times a second, which is doubtless explainable by the number of revolutions of the motor, 1800 per minute, or 30 per second. Smaller disturbances are also revealed, which would indicate a lack of balance in the motor. Insulating supports are planned for the machine and after these are installed, further photographs will be taken for comparison.

Additional experiments are planned in which vibrations of controlled frequency will be generated by a special machine under varying conditions; thus giving results where the action of the source is well understood. The information thus gained will be useful in the interpretation of vibrations in buildings.

The experimental problem is two-fold in its nature. First, to locate the sources of disturbance rapidity of vibration increases, the susceptibility increases also. According to one observer the motion is barely perceptible when the maximum velocity of the alternating motion reaches values from 0.01 to 0.10 centimeters per second, and the disturbance becomes a nuisance for velocities from 0.14 to 0.40 cm. per second. Another observer reaches the conclusion that the susceptibility depends on the acceleration of the motion, and that the motion becomes a nuisance when the acceleraiton becomes equal to or greater than 5 per cent of the value of gravity[2]. The solution of the experimental problem, so far as the effect on people is concerned, thus requires the opinion of people in addition to the taking of instrumental measurements.

Other aspects of the problem might be discussed, but enough has been set forth to show the general nature of the problem and its probable solution. The details concerning the analysis and correction of vibrations depend on the future investigations of the subject.

[1] A Portable Seismometer. Journal of Optical Society of America, Vol 6, page 629, 1922.

[2] See book by Alex B. Eason, "The Prevention of Vibration and Noise," Chapter 2.

Preparation of Lumber from Logs in a Sawmill

G. W. Mattson, g.e., '24

The American people are engaged in various industries, among which the preparation of lumber holds an important place. Lumbering has gradually grown from an unsystematic process into a systematized branch of business. The increasing demand for lumber in the construction of bodies for automobiles and aeroplanes, and for other purposes which have come into recognition recently have made necessary the development of efficient methods for the preparation of lumber from the raw material. Following in the wake of the rapid decrease of American forests, the engineer has been confronted with the problem of utilizing the trees to the best advantage and of adopting the most economical procedure in their preparation. The felling of trees and their transportation by steam and rail to the saw mill, comprise a part of the scheme used in lumbering. In this conveyance, however, the material is still in a raw state, that is, in the form of logs. The production of lumber from this raw material at the saw mill is the most important step in the entire lumbering industry, and is the process with which this article has to do.

If the logs are to be transported by rail, which is ordinarily done if they are to be prepared in the modern sawmill, they are piled lengthwise on flat cars, one on top of the other, and held in such position by means of upright pieces fastened to the sides of the car. On arriving at the mill, the logs are unloaded at a location from which they can be easily and conveniently handled. When logs are brought to the Ford sawmill at Iron Mountain, Michigan, they are piled in six great rows, one and one-half miles long, next to parallel railroad tracks. Four clamshell hoists are used to stack the logs. Fordson tractors with their front wheels replaced by sled runners are used to haul the raw materials from the forests to the storage pile. From the storage pile they are loaded onto flat cars as explained above and transferred to the saw mill.

A reservoir, as shown in Fig. 1, is built immediately outside the mill, and contains sufficient water to carry the logs necessary for continual operation. A conveyor emerging from one end of the water pool rises at an incline and passes up into the mill. Men are employed to cant the logs from the piles into the water and to guide them to the chain conveyor. The projecting links on the moving chain take hold of the log and carry it slowly up the incline into the mill, as shown in the view. Electrical power is used to drive the conveyer.

On reaching the interior of the mill the logs are pushed down an incline and away from the moving chain. Due to gravity the logs move down the slopes until stopped by the projecting dogs on the platform. When in this position the logs are ready to be placed on the carriage, which carries them through the moving saw.

The purpose of the carriage is to hold the log rigidly while being inserted in the saw and to serve as a means of adjustment when the thickness of the cuts are to be varied. The carriage consists of a framework supported on four iron wheels which travel along steel rails at an enormous velocity. It is operated by steam and its motion is transmitted by a piston moving forward and back in a cylinder of considerable length.

The movement of the carriage is controlled by the sawyer, who is stationed in a box near the saw and a short distance from the carriage. The sawyer

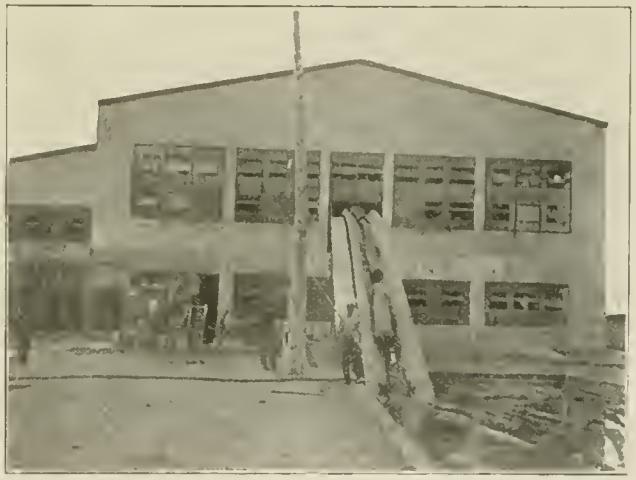


Fig. 1. Conveyor and Storage Reservoir

has supreme control over the entire operation. By means of a system of levers he may stop or start the saw or the carriage as circumstances demand. He decides the most economical cuts and gives orders accordingly.

The carriage proper or rather its mechanism is operated by three men stationed on it. Two men are employed as doggers, who clamp and release the log and adjust it for new cuts, acting according to requests of the sawyer. The third man gauges the

thickness of cuts to be made and operates the gauging instruments to comply with the wishes of the sawyer. All of the above mechanism is operated by small electric motors stationed on the carriage. Every movement and adjustment is made while the carriage is in rapid motion, thus reducing the time of operation to a minimum. Active minds and skill are required of the men who act in these hazardous positions.

When the carriage is ready to receive a log it is stopped directly in front of the incline mentioned above, on which the logs are held in position by the projecting dogs. The dogs attached to one continuous shaft are turned over by the operator, and the log sent forward by a jigger emerging from beneath. The jigger merely consists of a piston moving up and down in a cylinder, the motion of which is controlled by the steam pressure. The moving log rolls upon two arms projecting from the carriage and upon these the material is supported and securely clamped. Then the carriage is sent forward and the log is introduced to a moving band saw, which cuts through the entire length of the material. The carriage moves through a distance sufficient to allow the log to pass the saw, when it is reversed by the return stroke of the piston and moves in the opposite direction. During this small interval of time the log is readjusted and made ready for another cut. Large helical spring shock absorbers are stationed at the termination of the piston stroke to absorb the energy imparted by the moving carriage and to make possible a rapid reversal in direction.

Steel band saws ranging from thirty-two to forty-five feet in length and about twelve inches in width, as shown in Fig. 2, are employed by the Ford sawmill to do this work. After continuous cutting the saw becomes heated, the teeth lose their cutting edge, and it tends to twist slightly out of shape. To insure progress under such conditions the saw must be replaced by another which has been cooled and sharpened. The picture shows a saw being resharpened and set by an automatic machine at the Ford sawmill. Speed and accuracy are obtained by these machine operations. Every tooth is sharpened and set alike, thus insuring efficient service when passed through the raw material.

When the strips are cut out of the log they drop on steel rollers, operated by electric motors, and are carried forward. The strips of wood and pieces of lumber vary in width and thickness, and are distributed by the rollers to the different machines. Operators are stationed at various points in the plant to control the conveyers carrying the lumber to the various machines for further refinement. Gang saws, whose motion is generated by steam, operate twenty-six saws at one time. A piece of lumber passing through this machine is ripped into a large number of strips in one operation.

The lumber cut to the desired thickness and width is conveyed to the other parts of the mill to be reduced in length. It is carried up a small incline by means of moving chains and at the top are revolving circular crossent saws spaced at equal intervals between the chains and operating on one shaft. As the lumber approaches the revolving discs the saws penetrate the material and thus cut it into several pieces of equal length. The lumber passes on to the end of the plane and drops off, falling upon conveyers moving in a different direction and is carried out of the mill.

Along the route men are employed to grade the material, which is done by examining the pieces for defects and grain structure. A chalk mark is placed upon each piece to indicate its classification. Upon reaching the outside of the mill, employees select the lumber from the moving chains according to its grade and pile it in the respective places designated by the classification. The waste material also drops on a series of moving links and is carried out to the furnace. Here it is converted into fuel and is

Fig. 2. Band Saw Used in Lumber Mill.

used to supply the steam necessary for operating the machinery of the mill. At the Ford sawmill sufficient fuel is obtained from the waste product to generate enough steam for the operation of the entire mill. The dust particles are removed from the waste material in order to insure a clear atmosphere in the mill. A stack built over the conveyer permits the dust to rise and pass up through the stack due to a decrease in pressure brought about by removing the air within.

The lumber obtained from the green logs is unfit for immediate use. Dry kilns are used by the Ford Company to hasten the removal of moisture from

(Continued on Page 152)

Applied Science and the Engineer

L. B. Breedlove, M.E., '14

The history of the industrial era in which we are apparently quite well advanced proves that the application of science and the commercialism of inventions to the benefit of a great number of persons are the most significant factors promoting the happiness and elevating the standard of living of all individuals throughout the world. Invention and the commercial applications are at an ever increasing rate effecting all phases of our economic, commercial and social organizations, and after a review of all other influences, it is apparant that applied science is the greatest civilizing influence in the world. Each new invention that knits society closer together, eliminates distance as a stumbling block to better undestanding and facilitates the spreading of education and knowledge, is in itself a factor in building civilization. We are living in an age of great material progress, but this progress is leading us forward both morally and intellectually, as well as carrying these advancements to all parts of the world. Since the world has depended on science rather than dogma for progress, we have advanced many fold more in each decade than we did in each century before. The development of applied science will probably in the not too far future reach a stage in which wars cannot be countenanced, and invention will force some sort of an association of nations to preserve civilization.

The increasing importance of the work of the scientists and the engineer is bringing greater responsibilities, and, if the full economic development is to be realized in the future, these responsibilities must be assumed more generally than is at present appreciated. This war brought forth a wonderful change in the mental attitude of people throughout the world, with the result that most established ideas are being gradually discarded and replaced by new ones on which, wrongly or otherwise, our future progress will be based in many ways.

The scientist is concerned primarily with the discovery and operation of the physical laws, while the engineer is concerned with the art of managing and developing materials, human nature and capital, to weave these principles into a commercial and financial success. The best commercial and financial success usually comes when these principles are brought by the engineer to the enjoyment and utilization of the great mass of the human race. The work of the scientist is already far in advance of the commercial uses made by the engineer, and properly so. A large amount of the work of the engineer dealing solely with scientific facts has been accomplished, but the commercial application has hardly begun.

Among technical men there is a common desire to be of greater economic service and this is the result of a more intellectual age, but with this spirit of service discontent is growing rapidly in many professions and particularly in the engineering profession. Engineers are today analyzing and discussing freely the short-comings of their professional training and their professional organizations. This is regarded as dangerous by many who misunderstand and misinterpret the value of discontent. When analysis and added effort are used to discover applications of technical training and ability, discontent points to great progress, yet in all steps of progress past ideas are freely discarded. There are enough statistics available now to indicate considerable change in the engineering profession.

My duties include reviews of the work of the engineer, of business management in all its phases and of the financial plans of utilities either established or proposed. This review is for the purpose of supplying money to the organization, or for advising financial institutions regarding the investment of funds. These duties give me a very good and accurate view of the work of each class of artisan, and a conception of how successfully each uses the tools of his profession. I am impressed with the relatively poor showing made by the engineer in comparison to the economist, accountant, lawyer and manager. This is not due to his lack of equipment or his grasp of detail, small or ponderous, but may be attributed to his narrow vision, over-specialization, and the lack of knowledge of the commercial problem in its entirety. In his case it is the lack of proper application of the different branches of science and probably results from education along industrial divisions instead of functional division as sales, management, etc. The facts must be faced. Engineering questions of importance are decided a great many times without getting the opinion of engineers. In many cases engineers' expert opinions are received and then disregarded. An engineer's recommendations, be they ever so wise, are worth nothing if they are not accepted. The engineer owes a duty now generally neglected,

(Continued on Page 164)

Decatur's Water Supply Development

E. C. Hartmann, c.e., '24

In presenting this paper the writer has two purposes in mind. The first is to present as a matter of general interest, such data as he was able to collect concerning this project, and the second is to bring before the minds of the engineering students at the University of Illinois the fact that within a two hour ride of Urbana is as interesting an example of the work of an engineer as will be found in this part of the country. This article will deal only with the supply itself since this is the one item involved in the recent development at Decatur. The treatment of the water and the method of pumping were not altered and will not enter into the discussion, but a brief outline of the circumstances leading to the present condition and a description of the engineering features of the project will be given.

Decatur's first use of the Sangamon River as a source of public water supply came only after a disastrous fire in some woolen mills about 1875, which impressed upon the citizens the need of fire protection. In 1878, a timber dam was built near the site of the present dam raising the water some 4 1-2 feet above the mean stage and creating sufficient storage to take care of the city during the dry spells when the flow is very small. Decatur at this time had a population of 9,500. The timber dam was used without change until 1911 when the growing population required a larger reservoir. A small concrete dam was then built to replace the old wooden structure and to increase the storage by using a spillway elevation of 595 feet. The reservoir so constructed was probably inadequate as far as safety was concerned for the population of 32,000 which it was supposed to serve in 1911, and the need for a higher dam was felt as early as 1912. The urging of this need was increased in June of 1918 when the swollen Sangamon washed a large hole around one of the wing walls of the dam doing about $40,000 damage and imperilling the whole structure. Temporary fills of sand bags prevented further damage and subsequent earth fills made it possible to use the dam until the present one was in place. About this time Decatur started an intensive program of improvement along several lines, one of which provides the theme of this article.

About 1918, Pearse, Greely and Hansen, a firm of consulting engineers of Chicago, were called in to make a report on the water supply situation. The report was made in 1919 and included as a solution to the problem the following factors:

1. An earth and concrete impounding dam, 1900 feet long with 485 feet of spillway, raising the water 15 feet above the old dam.

2. A reservoir 13 miles long and about 1-2 mile wide, covering some 3400 acres and storing about eight billion gallons of water, a two year supply for Decatur without rain.

This solution was accepted as submitted and the contract for building the dam and raising the county bridge was let by the city to L. N. Cope and Sons of Decatur. All the rest of the work was handled and paid for by the Decatur Water Supply Company, a $1,000,000 corporation of citizens formed for that purpose. It might be of interest to note that the stock of this company was oversubscribed within five days after it was offered for sale. The work done on the project naturally divides itself into two parts, that paid for by the city, and that paid for by the Water Supply Company, and it will be treated under these heads.

The contractors began construction at the dam on July 15, 1920. The program was roughly as follows: 1. Raising the county bridge; 2. Building the north embankment; 3. Building the south embankment and bridge approach; 4. Constructing the spillway. Although the construction of these overlap, they will be discussed separately.

The county bridge is on a skew with the spillway, and its south abutment is integral with that of the spillway as shown in Fig. 1. Its south approach

New Highway Bridge Across Lake Decatur

was rebuilt to form the south embankment of the dam as will be discussed later. The bridge consists of five deck girder spans and was raised by

hydraulic jacks to a height of 15 feet above its former elevation. The abutments were raised and the wing walls extended to take care of the new fills. A pavement of bituminous macadam was laid on both approaches.

The North embankment of the dam is 537 feet long and has a 3:1 upstream and a 2:1 downstream slope. In constructing this the ground was first stripped and a line of wood sheet piling was driven to hardpan. Where difficult driving or thick sand layers were encountered, Lackawanna sheet steel piling was substituted for the wood. The earth was then put on in approximately four-inch layers and compacted by so routing the teams and wagons over it that all parts were worked. A puddle core wall was constructed around the top of the sheet piling to make certain the impermeability of the dam. The elevation of the top of this embankment was 623, or 13 feet above the spillway. A four-inch slab of 1:2:4 concrete resting against a toe wall was used in paving the upstream face. It was placed in 10-foot squares and was underlain with a system of gravel drains. The unpaved portions were either sodded or seeded to prevent undue erosion.

The south embankment is 869 feet long and forms the south approach to the bridge. It differs from the north embankment in that its upstream is 2.5:1 instead of 3:1; construction methods being the same. The total volume of embankment was 65,000 cu. yds. It should be understood that none of this came in the channel of the river.

The spillway section lies between the two embankments and is directly across the channel. A section of this 485 foot spillway is shown in the accompanying drawing (Fig. 2) and needs but little explanation. The normal top elevation is 610, or 612, with the movable flash boards in place. In the latter case a rise of 17 feet over the old dam is obtained. Provision has been made in its design to add another five feet of concrete to this section when that change is made necessary by the growth of the city.

Fig. 1. A View of the Decatur Dam Showing Spillway, Gates and County Bridge

The spillway was built in two parts in order that the channel might be left open during construction. The cofferdam for the north half and the gates was built first and was made of Lackawanna sheet steel piling strengthened with wood piling. A timber trestle work carried a narrow gage rail road out around the edge, so that the concrete might be easily delivered from the central mixing plant.

The drawing shows a line of steel piling along the front of the spillway. This connects with the wood sheet piling under the embankments, forming a continuous wall under the entire dam. The round bearing piles shown were notched as soon as driven so that the concrete would hold securely to them when in place. When the bottom of the cofferdam had been properly pumped out and prepared, a

thick slab of the spillway foundation and the apron were poured. This apron was reinforced with 25-pound steel rails laid on two-foot centers perpendicular to the axis of the dam. After the foundation slab had set, a Blaw Knox travelling steel form was set up on rails and used to pour alternate 18 foot sections of the spillway. Later it was used to fill all but two of the remaining sections, these two being left open to help the flood gates carry off any high water which might occur during the construction of the south half of the spillway. (A description of the Blaw Knox forms can be found in the Engineering News-Record, Volume 88, No. 11, Page 452.) The gates at the north end consist of two 36 inch circular sluice gates, one 48-inch square flushing gate, and two 9-foot by 11-foot flood gates.

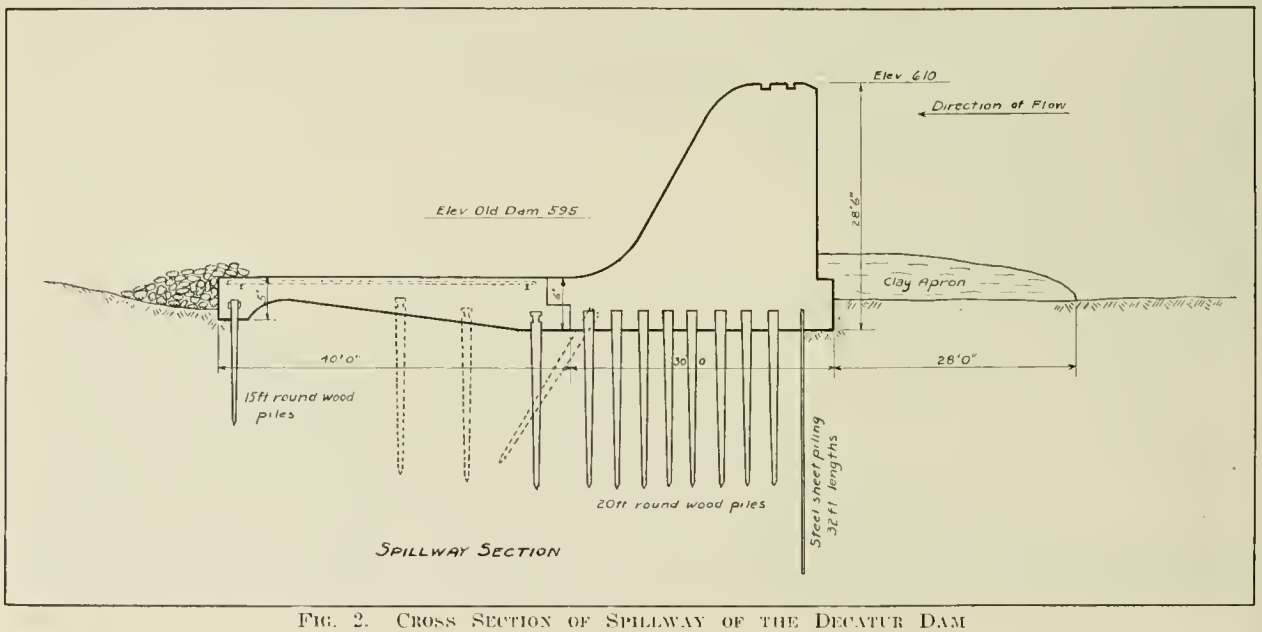


Fig. 2. Cross Section of Spillway of the Decatur Dam

When the north half was finished, excluding the exception noted, the piling of the cofferdam was pulled and redriven to form a cofferdam for the south half. The methods used were the same here except that there were no gates or open sections to bother with. The concrete used in the spillway was 1:2.5:5, using gravel as the coarse aggregate, and was mixed at a central plant near the north end of the north embankment. From here it was taken to the work in side dump cars on the narrow gage track mentioned in connection with the cofferdam. The yardage of concrete is as follows: spillway, 10,300; gates, 820; apron, 4,000; abutments, 6,950; total, 22,010. The total cost of the dam to the city was $904,750 and was paid by means of a general assessment bond issue.

The work of the Water Supply Company was of a different nature than that described above. First, there was the purchase of all land within the 625 foot contour, involving condemnation proceedings, and numerous lawsuits. Then there was the old Cowford wagon bridge which was replaced by a new cantilever structure, and the necessary work of raising its approaches. A view of the cantilever bridge is shown in Fig. 3. The old Moffet wagon bridge was wrecked and its long approaches cut down below the 605 foot level. Four other highway bridges were raised and two new lake drives were built under the supervision of the company. The basin land inside the 615 foot contour was all cleared of timber and buildings. All embankments for approach grades had to be rip-rapped to prevent washing out, and therein lay considerable trouble. The first system was to simply lay large concrete blocks directly on the earth. They were supported along the top of the slope by a row of timber piles with wales running between them. When the first high water came nearly all the blocks washed out, so that in replacing them a different method was used. A line of wood sheet piling was driven along the wales at the top of the slopes to strengthen them. Then a bedding of bricks and gravel was placed on the banks and the blocks laid on top of this. So far the new plan seems satisfactory. Up to December 31, 1923, the total capital expenditures of the company had reached $1,240,930 which gives a good idea of the size of their end of the work. The reservoir has been named Lake Decatur and was made a state game preserve.

The question of power development at the dam was investigated by the same engineers who designed it but was not thought to be feasible. This would have added the final touch of interest to the project from our point of view as students.

The 1924 Electrical Show

With the establishment of a greater loan fund for electrical engineering students as its motive, the E. E. Society will present on April 24, 25, and 26 the most complete Electrical Show which it has ever been able to produce. The men in the department, imbued with the creative spirit have for many weeks been engaged in the actual construction of a series of exhibits which will illustrate fully the possibilities and progress in the electrical world. This early start will enable the production of many stunts such as the automatic electric railway exhibit which requires months to complete. The organization of the show was announced early in the year, and its personnel has been since engaged in making the full plans. C. T. Parker is General Manager. His assistants are: G. G. Robinson, Chief Engineer; J. T. Jackson, Business Manager; and R. J. Crandall, Treasurer.

Probably for the first time on the campus actual radio control of a vehicle will be displayed. This much discussed problem will be one of the chief attractions of the show. Either a boat or other small craft will be guided and propelled from a control panel board through the use of wireless waves. There will also be a short wave exhibit in which exceedingly short radio waves will be generated, sent out over the small antenna, (a large one being unnecessary with these short waves) and picked up and measured on a bridge built for the purpose. The bridge and some of the other apparatus is already constructed. Electrical music, the Reinhardt moduloscope, the Neutrodyne, super-regenerative set, and radio compass stations will also be features of the radio exhibit.

The electric railway equipped with block signals and automatic train control which was a feature of the last show will be rebuilt on a much larger scale this year. Arrangements have been made for the rolling of small steel rails with which to construct the track. The ties will be of wood, and ballast of pebbles will complete the right-of-way. The exhibit will consist of over 400 feet of track all equipped with automatic signals and train control. The switches will be electrically operated so that the entire system may be operated from a control station. The eight cars to be used are models of the North Shore Electric Lines, each having two motors. Besides these a locomotive which is being built by W. E. Lyons will be operated. It will have two motors and eight drivers, and will be a prototype of the large locomotives now in use.

Another feature of the show will be the large Telsa high frequency coil which will give a nine to twelve foot spark. The voltage will be in the millions and the peculiar properties of high frequency currents will be fully demonstrated. The singing arc whose tone depends on the tuning of a circuit by varying the capacity and inductance will also be displayed. It is the work of some of the men to construct an automatic dog which will follow a cane and have no external connections whatsoever. Manual and automatic telephones and their interconnection as used in Urbana and Champaign will also be demonstrated by means of switch boards inter-connected between the Gym Annex and the E. E. Laboratory. Electric arc welding will be thoroughly demonstrated in one of the exhibits. The stunts described above are but a few of those which are to be placed before the public in April. There are novelties, educational explanations, and models, in addition to apparatus built in the laboratory and used in the routine work. A model amusement park will entertain, while the Poulsen arc or Eugene resonator will involve the technical phases of electrical engineering.

As before, the Show will occupy the E. E. Laboratory and the Gym Annex. A large fountain will occupy the center of the gym and add its touch of beauty to the dazzle of illumination. From seven to ten thousand persons see the show every two years, with the possibilities of a larger number this year. The traveling electric sign placed in Champaign before the opening of the show is an engineering problem of magnitude. There are some three hundred contacts which are made and broken by an endless ribbon about thirty feet long which passes over a long plate and spells out the words on the sign.

The Electrical Engineering Society has been able to establish with the profits of previous shows, a $1,000.00 loan fund for the benefit of E. E. students. The faith and co-operation of the E. E. students in this show has been evidenced by the fact that they recently pledged $1,000.00 to make up for any possible deficit which might occur this year. The University is one of the few fortunate universities in which a show of this nature and magnitude is regularly produced.

The Short Course in Highway Engineering

The Short Course in Highway Engineering just held was in many respects the most successful of the eleven meetings of the kind that have been held at the University. The attendance was the largest with the single exception of 1920, when the State Division of Highways sent in nearly 300 of their men. This year the total number registered was about 300. Many university and twin city people attended without registration, so that in all probability, 400 or more attended the meetings at various times.

The sessions opened on Monday morning, February 18, with a roll call of the various interests represented, followed by the usual addresses of welcome and response, after which Prof. Williams., Head of the Civil Engineering Department, gave a short talk on "Important New Developments in Civil Engineering." This was followed by a general discussion of a number of details of alignment and grades of highways led by Prof. C. C. Wiley.

In the afternoon Senator Richard R. Meents gave an interesting talk on "Good Roads—A Community Asset," in which he pointed out the various advantages to a community other than those of a purely financial character that are to be derived from a system of improved highways. He was followed by Mr. H. E. Hilts, Deputy Engineering Executive of the Pennsylvania State Highway Department in an exceedingly interesting and rather technical discussion of "The Economics of Location of Highways." He showed by numerous examples and extensive statistics that after all the cost of operation of traffic over the highways is the important item and that almost any expense may be justified in reducing the distance traveled and in reducing grades to suitable limits. He explained also the traffic studies that are being made in Pennsylvania with the cooperation of the United States Bureau of Public Roads to arrive at the character and distribution of traffic within the state.

In Tuesday morning's program the greatest interest centered around "Illinois Highways—Past, Present, and Future," by Mr. Frank T. Sheets, State Superintendent of Highways of Illinois. In this discussion he briefly outlined the work already accomplished and the work proposed for the year 1924, after which he launched into a presentation of the proposed 100 million dollar bond issue. In this he pointed out by means of charts, statistics and estimates that it is entirely feasible to finance the 100 million dollar bond issue in addition to the present 60 million dollar bond issue from the proceeds of the automobile fees on their present schedule of rates. He further pointed out by means of statistics that the construction of such a system of highways within a period of 5 or 6 years would yield an economic return to the automobile owners of the state vastly in excess of the total principal and interest charges involved in the bond issue. Anyone who heard his address or has analyzed the figures submitted can scarcely help but be convinced that the economics of the proposition are entirely sound.

The afternoon session of Tuesday centered largely around the discussion of "The Contractor's Problems, Troubles and Joys," which was discussed in turn by a grading contractor, a gravel-road contractor, a concrete road contractor, and a bridge contractor. Following this Mr. A. E. Horst gave an interesting discussion of "Bidder's Bonds versus Certified Checks at Highway Lettings." A considerable number of contractors were present at this meeting.

On Wednesday the principal interest centered around the discussion of "Practical Conclusions from the Bate's Road Test," by Clifford Older, former State Highway Engineer of Illinois; "Traffic Studies," by J. Gordan McKay, of the U. S. Bureau of Public Roads; and "Highway Marking, Maintenance and Snow Removal," by Frank F. Rogers, State Commissioner of Highways of Michigan.

Practically all of the program of Thursday morning related to earth road construction and maintenance, and especially to a discussion of oiled earth roads. The entire afternoon was taken up with a discussion of road laws which was of great value to all those who attended. Thursday evening the annual dinner was held at the Urbana-Lincoln Hotel. About 140 attended and had an unusually enjoyable time. Prof. J. W. Garner, Head of the Department of Political Science of the University gave a decidedly timely and forceful talk on "Some Proposed Methods for the Maintenance of International Peace."

On Friday morning, Prof. T. R. Agg, of Ames, Iowa, brought the Short Course to a close with a very clear, convincing talk on "Highway Operating Costs as Affected by the Road Surface." He showed a great deal of experimental data, which on one hand tended to verify conclusions as given by Mr. Hilts, that almost any expenditure

(Continued on Page 152)

Localized Stresses

C. C. Young, g.e., '24

Failure Due to Localized Stresses

The gears, crank shafts and connecting rods of the Liberty aeroplane engine of the first design frequently failed. The failure started, in the gears at the bottom of the teeth where a sharp corner occurred, in the crank shafts at the corner of the keyways, and in the connecting rods at the sharp corner where the connecting rod bolt head fitted on the assembly. The British Air Service found that, when a failure was due to a sharp corner, many failures would occur in engines of the same type in approximately the same number of running hours. The trouble in the Liberty motor was greatly reduced by adopting a small fillet at each corner, the purpose of the fillet being to reduce the localized stresses to which many failures were due.

Localized stresses are stresses in some particular area or fiber of a member which are greater than the stresses in the surrounding areas of fibers due to an initial strain, or to an imperfection of the material, or to a change in cross section of the member. They are stresses which cannot be calculated by ordinary methods of determining stresses. They consist of the ordinary stress which is equal to that in the surrounding fibers, and an additional stress which may exist as an initial strain or may be set up when a load is applied at sharp changes of section. Stresses due to an uneven application of loads will not be considered as localized stresses.

Conditions Causing Localized Stresses

Initial strains may be set up in steel by the mechanical process of rolling. Especially if the metal be somewhat cold, the forcing of a sliding movement among the fibers or crystals in elongating the bar leaves it in a strained condition. Heat treatment such as quenching also produces such strains. Recent experiments have proven that sudden changes in section, such as sharp corners greatly affect the distribution of stress in a member. It will be shown later that if two members of the same material and dimensions, (such as the crank pins in Fig. 1), but one having a filleted shoulder and the other a sharp shoulder, each to be subjected to an equal load P, the stress at A will be about 50 per cent greater than that at B.

Localized stresses are also set up around scratches and indentations due to hammer blows or lathe tools. A rivet hole in a member under stress may cause a maximum stress as much three times as great as the average stress. Preuss has shown (Journal of the Iron and Steel Institute, volume 96, page 143) that the stress distribution in a plate in which a round hole has been drilled, is approximately as shown in Fig. 2, when subjected to a tensile load. The stress distribution due to these holes is duplicated on a small scale by blow holes in the material and by minute sections of impurities. These cause a "break" in the transfer of stress from fiber to fiber.

Significance of Localized Stresses for Static, Impact and Repeated Loads

Localized stresses are of greatest importance in the case of repeated loads, and it was the failure of members subjected to repeated loads when the calculated stress was below the elastic limit, that led to the investigation of these unknown stresses. If a ductile member be subjected to a static load, localized stresses are relatively unimportant. The overstressed portions merely stretch until they are

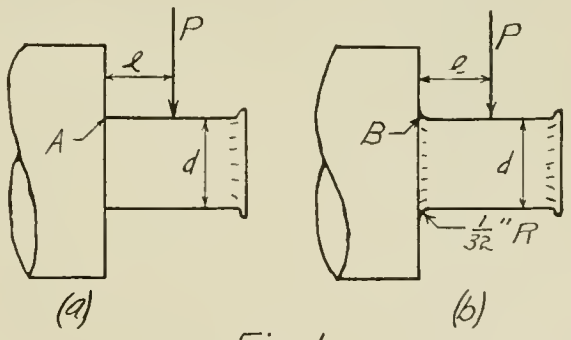


Fig. 1.

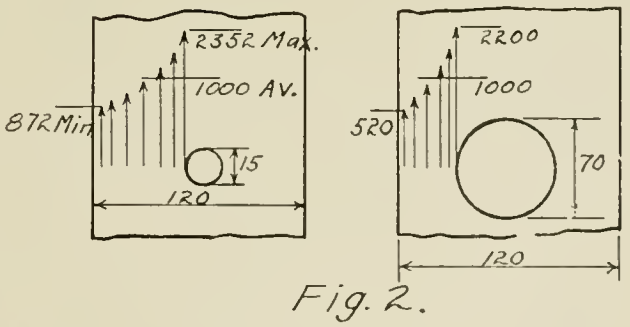


Fig. 2.

relieved by surrounding parts and no rupture occurs. However, if the material is brittle, localized stresses are more serious, since then the overstressed fibers will break before they can stretch enough to be relieved by surrounding fibers, and rupture may occur. For this reason ductility is essential for structural members. The designer in assuming that each rivet of a joint takes an equal

amount of stress knows that this is only an approximation. He depends upon the ductility of the metal to relieve the overstressed parts.

In the case of impact loading, localized stresses are more serious than they are for static loads. This is due to the nature of impact loads and impact strength. The elastic impact strength of a material is the maximum amount of energy the material can absorb per unit volume when resisting an impact load, without developing a unit stress greater than the elastic limit of the material. This may be expressed by the formula, $U = e^2/2E$, where, U, is the elastic impact strength in pound-inches, e, the elastic limit of the material in pounds per square inch, and, E, the modulus of elasticity of the material in pounds per square inch. Now if a weight, w, be dropped a distance, d, upon a bar of length, l, having a constant cross-section, a, as shown in Fig. 3, the energy that must be absorbed by the bar is w (d + c) pound inches, where c is the total deformation of the bar. That is, assuming that the bar

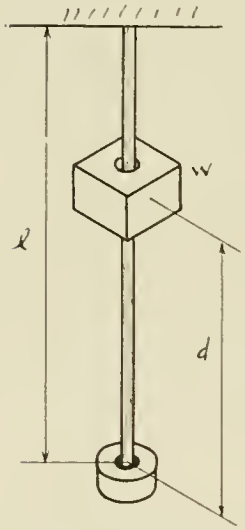


Fig. 3

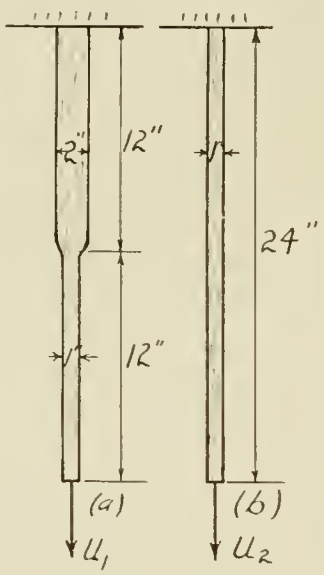


Fig. 4

absorbs all of the energy of the load, $U_1 = w(d+c) = S^2al/2E$, where, U_1, is the actual impact load, and, S, the stress due to w (d + c) is assumed to be uniformly distributed over the entire area of every cross-section. Now, if there were some initial strain in some part of the bar, or if there were some change of section to cause localized stresses to be set up the instant load is applied, the stress is those parts would be considerably greater than S. This increased stress may cause a bar which is amply able to absorb its impact load to fail. Some sections are stressed to the breaking point while others take little of the load. The importance of a uniform distribution of stress may be illustrated by the following problem. It is required to determine the respective impact loads that two steel bars in Fig. 4, can absorb, allowing a safe working stress of 20,000 pounds per square inch. The two bars are of the same material and all corners are well rounded.

First let us consider rod (a). The stress in the lower part of (a) should not exceed 20,000 lb. per sq. in. Since the stresses in the different cross-sections vary inversely as the areas of the sections, the stress in the upper part, when that in the lower part is 20,000, will be $20{,}000\ A_1/A_2 = 20{,}000/4 = 5{,}000$ pounds per square inch. A_1 and A_2 are the respective areas of the lower and upper sections. Now since, $U = S^2al/2E$, the safe impact stress of rods (a) and (b) may be determined by substituting the values of, S, just found. Solving as outlined, it is found that the safe impact load for rod (a) is only 78.5 pounds per square inch, while the safe impact load for rod (b) is 125.6 pounds per square inch.

The difference in strengths in this case cannot be blamed entirely on localized stresses, but there is a close connection between the stresses in (a) and localized stresses. The stress in (a) is "localized" in the sense that it is greater in some sections than in others, although the difference in stress is easily calculated. For static loads, rod (a) would be equal in strength to (b).

When repeated loads are considered one finds a great amount of evidence of the existence of localized stresses. In almost any machine with moving parts there are members subjected to repeated loading. Thus the shaft shown in Fig. 5 is subjected to a complete reversal of stress for every revolution.

It has been found by experiment that a specimen of hardened and tempered steel, whose ultimate strength is 97,000 lb. per sq. in., and whose elastic limit is 84,000 lb. per sq. in., will fail if subjected to a large number of complete reversals of bending stress (such as that in the shaft in Fig. 5) at about 56,000 lb. per sq. in. A specimen of 0.3% annealed carbon steel whose ultimate strength is 69,000 lb. per sq. in., and whose elastic limit is 35,000 lb. per sq. in., will fail under similar loading at about 30,000 lb. per sq. in. In these tests the specimens are highly polished and great care is taken that no sudden changes of section affect the test. Such failures are explained by the theory of localized stresses. Certain fibers in the member are stressed beyond their ultimate strengths due to some initial stress or to some nonhomogeneity of material. These overstressed fibers fail a few at a time, gradually forming cracks which widen until rupture occurs.

Repeated Load Method of Determining Localized Stresses

The highest unit stresses which (applied in cycles of completely reversed bending stress to a specimen) can be withstood an indefinite number of

times without failure, is called the endurance limit of the specimen. The usual method of testing is by rotating a small specimen loaded as a simple beam, as shown in Fig. 6. The endurance limit of highly polished specimens in which localized stresses are prevented as far as it is possible to do so is termed the endurance limit of the *material*. This endurance limit of the material depends upon the strength, homogeneity, heat treatment, etc., of the material. The endurance limit of a machine part made of this

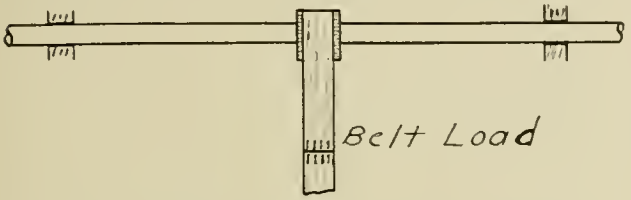


Fig. 5

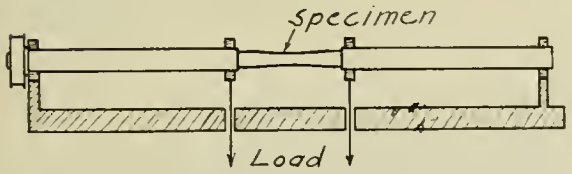


Fig. 6

material is usually lower than the endurance limit of the material due to scratches from lathe tools, or changes in cross-section. In order to calculate the stress in such members the ordinary formula must be corrected with certain factors obtained by experiment. Thus, in the case of the crank pin in Fig. 1 (a), if there were no localized stress the stress at A would be calculated by the flexure formula, $S = Mc/I$. Experiments with repeated loads indicate that the stress at A is about twice that, due to localized stresses at the sharp shoulder. That is $S_1 = 2\ Mc/I$. (S_1 = stress at A; S_2 = stress at B).

Now, if the corner be rounded with a small fillet (Fig. 1b) the stress will be considerably reduced, and $S_2 = 4\ Mc/3\ I$, will now give the approximate value of the stress. Dividing the latter equation by the preceding one, and solving for S_2, it is found that $S_2 = 2\ S_1/3$. The great advantage of even a small fillet is evident. By making use of the fillet, the stress is reduced by one-third for the same loading. This explains how the trouble with the Liberty aeroplane engine, mentioned above, was eliminated by using fillets at all corners.

Such constants as those used above are merely correction factors which must be introduced into the ordinary formula to take account of localized stresses. Careful experiments are necessary to determine these constants and at the present time there are few of them accurately determined. Rapid progress is being made, however, in many testing laboratories, among the foremost of which is the repeated load testing laboratory of the University of Illinois, under the direction of Professor Moore.

Other Methods of Calculating Localized Stresses

While localized stresses are more easily and accurately determined by the use of repeated loads, there are several other methods of calculating them. Coker of England, Paul Heymans of Belgium, and others have recently performed some valuable experiments in photo-elastic stress analysis. Briefly their method is: to make models of machine parts of xylonite (form of celluloid), to subject these models to the same type of loading that the actual part has to withstand, and to photograph the stressed model while rays of circularly polarized light are passed through it. The color of the image obtained depends upon the stress in the reflecting part, so those parts under the greatest stress may be seen. Since xylonite obeys Hooke's law, as does steel, the greater stresses in the model are at the same points as the greater streeses in the actual member.

Among the other methods of calculating localized stresses are: 1. Loading a whitewashed, ductile specimen to its yield point and determining where the stress is greatest by means of the cracks in the whitewash; 2. A more complete mathematical analysis, using the elastic theory to determine secondary stresses; 3. Using a model of plastic material which will hold its distorted shape after being loaded: stress will be proportional to distortion; 4. Using a rubber model.

Methods of Preventing Localized Stresses

One of the big problems facing engineers today is the reduction and prevention of localized stresses. A refinement of grain structure and the reduction of nonuniformity in materials will help some. A greater knowledge of the effects of different shapes of parts, as regards localized stresses will also help. A better knowledge of the properties of the different materials will insure that the proper materials, given the most advantageous heat treatment, will be used for the purpose they are most suited. Particularly in the field of alloy steels is there much to be learned in this line. At present the following rules seem to be the most important for the reduction of localized stresses:

1. Use materials which are as homogeneous and uniform as possible:

2. Fillet all parts where cross-section must change; avoid all changes in section possible;

3. Polish all parts subjected to repeated loads. Avoid scratches, rough places, and indentations.

Manufacture of Chemical and Scientific Porcelain

J. W. McHugh, cer.eng., '24

There are comparatively few people who know that one of the results of the world war was the establishment of a chemical and scientific porcelain industry in this country. Before 1915, Germany and Japan made all the chemical porcelain used in this country and since they could undersell any American product, due to the cost of labor and the difficulty of manufacture in this country, these two countries had a practical monopoly on the porcelain industry. This was quite similar to the dye situation before the war.

About 1914, a pottery, which afterwards became the Coors Porcelain Company of Golden, Colorado, started the manufacture of white kitchen ware. In 1915, this plant changed to the manufacture of chemical and scientific porcelain. They started this undertaking in the face of tremendous difficulties for they had very little knowledge of the technique of pottery making, they were inexperienced and they were handicapped by a lack of proper equipment.

In spite of these difficulties and undaunted by heartbreaking setbacks, by the time that the United States entered the war, they were able to supply the government with the necessary chemical porcelain for use in munition plants and industrial laboratories. True, at first, this ware was of poor grade as compared with the German ware and would not stand up under severe treatment. But the quality of this porcelain has been steadily improving and judging the future from the past, within the next few years, this porcelain will be on a par with any foreign product. When Coors first started making porcelain he made only a few sizes and shapes but now he has advanced to the stage where he can produce over three hundred different articles for use in the chemical and scientific world.

All of the raw materials come from the so-called Denver basin which is rich in all kinds of clays, from the low grade brick clay deposits through high grade fire clays. There are large deposits of kaolin also but since these are contaminated with iron they cannot be used in a white burning body. Most of these deposits have not been exploited to any great extent and so present a wonderful future for the ceramic industry in that part of the country. The feldspar, silica sand, ball clay, sagger clay, fireclay, whiting and coal are all obtained in the near vicinity of this plant so the company is practically independent as far as raw materials are concerned. The china clay alone is imported from England. There are very few industries that can boast of a self-reliance such as this.

The body for this porcelain is ground wet in large ball mills for a period of twelve hours. The slip, which is this clay mixed with water to a consistency of thick cream, is passed through a vibrating screen which removes all unground lumps. Then the slip passes over a series of magnets to remove all iron particles that might cause slag spots on the

Porcelain Plant

porcelain. After passing the magnets the slip is pumped to a filter press which removes most of the water, thus leaving the clay with a known water content. The filter press cakes are next passed through a pug mill with enough water added to give the desired plasticity. After that it is stored in large moisture proof ageing bins to improve the working properties of the clay. The ageing process requires two months before the clay can be repugged and sent to the jigger line.

The clay preparation room is a model of cleanliness. All impurities such as iron or pyrites must be kept from the clay, as they will discolor the porcelain, forming slag spots. This room is cleaned thoroughly every day with broom and hose. The workers are required to wear rubber boots to prevent contamination of clay from the nails in the shoes.

A jigger is really a vertical lathe with a place

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A New Waterworks for Lewiston, Idaho

L. G. Straub, c.e., '23
Graduate Student

PART II—Design, Construction and Control of the Waterworks

Additions and extensions to the waterworks of the city of Lewiston, Idaho, will provide the city with an efficient and up-to-date system. The work consists in building a new intake line to be laid from the present intake to the present suction well, moving and re-setting present pumps, installing three low service pumps, and one high service pump and a wash water pump. Approximately seven miles of 4-in. to 16-in. pipe is being laid and two reservoirs are being added to the system. A purification plant, comprising settling basins, head house, filter house, pipe gallery, clear water basin, mixing chamber filter tubes and washwater storage tank, is another improvement under construction. A description of considerations entering into the design of the waterworks was given in the Technograph, January, 1924. The writer became familiar with problems met in the layout of the plant while working on the structural design details in the employ of Burns and McDonnel Engineering Company, the designers.

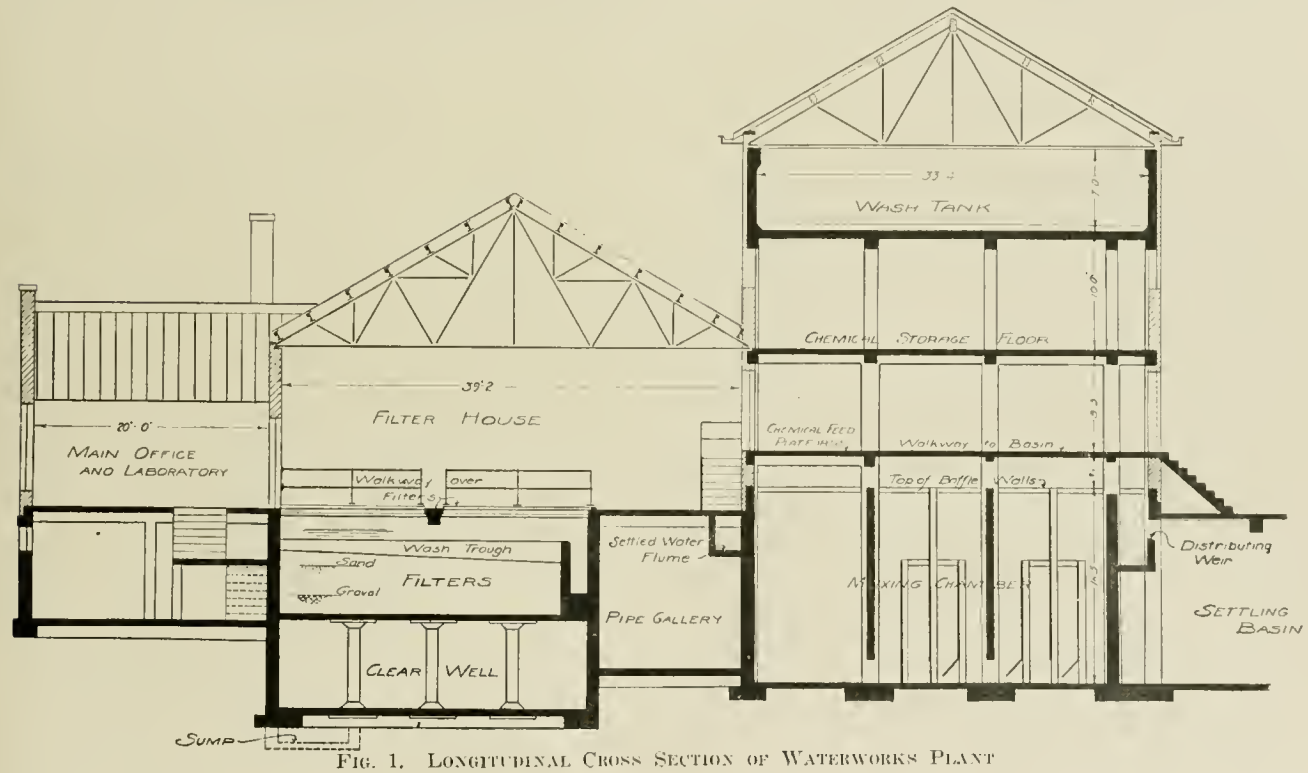

Fig. 1. Longitudinal Cross Section of Waterworks Plant

The intake for the water supply is located on the edge of the Clear Water River. Water is conveyed through underground conduits to a suction well or grit chamber from which the low service pumps take their suction. These pumps discharge through about 100 ft. of 16-in. pipe to a mixing chamber from which the water flows by gravity through the settling basins and filters. The filtered water is collected in the clear well from which the high service pumps take their suction. The high service pumps discharge to large storage reservoirs from which the city distribution system is fed.

All pumps are of the horizontal centrifugal type, direct connected to electric motors. The three new low service pumps have capacities of 1600, 2100, and 2800 g.p.m., respectively. They are designed to pump under an ordinary static head of about 20 ft. Only one new high service pump is being added. Its rated capacity is 2100 g.p.m. and is required to pump under a maximum head of 353 ft. A 2800 g.p.m. pump which is a part of the old system is also used to pump to the reservoirs. It is intended that ordinarily the high service pumps will be operated separately and only two of the low service pumps will be operated at one time.

Several unique features in structural design were presented in the purification plant. A longitudinal

section of the plant is shown in Fig. 1. The settling basins, a plan of which was shown in Part I of this paper, were designed as a group of continuous bents of four spans each. The distance center to center of bents was made 12 ft. and ten rows of bents were used. The space between the corresponding legs of the bents was spanned by a continuous slab acting as a horizontal beam designed to carry the hydrostatic pressure when the basin is flowing full and to carry the earth pressure from the outside when the basin is empty. The roof was designed as a continuous slab over the bents using a live load of 50 lbs. per sq. ft. As the center wall or baffle wall of each basin receives no bending stress due to latteral pressure, the leg of the continuous bent at this point was made flexible. This gave, in stress effect, a bent continuous over two spans with the top girder of each bent supported unrestrained at the center. The legs of the bents were assumed hinged at the base and are connected by 12 x 12-in. horizontal reinforced concrete footer ties.

All floors of the head house are of rectangular slab construction supported on four sides. On the top floor of the head house is the wash tank. A wash water pump and motor with an automatic starter controlled by a float switch is provided for filling the tank. The mixing chamber which is in the basement of this building is divided into large divisions by concrete walls; these divisions are subdivided by timber baffles. The chemical storage floor is just below the wash tank. Chemicals will be hoisted to the chemical floor on a one-half ton electrically-operated hoist which will lift the material from the roof of the settling basin.

The filter house, a one story concrete and brick building, has for the filter floor a Corr-Plate two-way-reinforced flat-slab design, and for the clear well floor a modified inverted Corr-Plate system. The drop panels in the latter case were placed below the floor to facilitate fabrication.

Each of the four units of the filter plant have a normal capacity of one and one-half million gallons per twenty-four hours when filtering at the rate of two gallons per minute per square foot of filter area. A collecting system for each filter consists of 10-in. cast iron manifold headers and 2-in. wrought iron laterals. The laterals are capped at one end and connected to the header at the other. Perforations, 1-4 in. in diameter are placed on the the bottom, 45 degrees each side of the vertical and on 6-in. centers. The supporting bed of the filters consists of gravel to a height of 18 in. above the manifold system. The gravel is uniformly graded and placed in four layers such that the stones vary in size from 1 1-2 in. in diameter at the bottom to 3-16 in. in diameter at the top. Above this is laid a hard clean sand having an effective size of approximately .40 of a millimeter and a uniformity coefficient of about 1.6. The sand is added to a height of 30 in. above the gravel.

An effluent rate controlling device of the venturi type is provided for each filter unit. The controllers are arranged to throttle the flow and to shut off the flow entirely when the water in the clearwell has reached a predetermined level. On the operating floor is an operating table for each filter. The tables are constructed of Tennessee marble and all exposed fittings are nickel plated. Each table has five levers for operating the following valves: (1) Influent (2) Effluent, (3) Waste, (4) Wash, and (5) Sewer. Dial indicators are used to show the positions of each filter valve at any degree of opening. Dials for the loss of head gauges are also placed upon the operating table. The gauges are of the mercury float type.

A float-actuated gage is used for indicating and recording the depth of the water in the clear well. Charts 8 in. in diameter giving a twenty-four hour record show variations in depth in feet and tenths of a foot.

A sampling stand on the operating floor accommodates sampling devices of the visible type to furnish water from the following sources: (1) raw water, (2) filter influent, and (3) filter effluent from each of the filters.

Coagulating chemicals are handled by three chemical dry-feed machines. Feed lines of 1-in. brass pipe are carried from the chemical feed machines to the mixing chamber entrances and to the distributing flume at points where water from the basins is admitted. Steel hoppers are provided for feeding the chemical from the chemical storage floor.

Chlorine is applied in the sump in the clear well at the point of high service pump suction. A Wallace and Tiernan vacuum "Type M. S. U." chlorinator having a maximum capacity of 24 lbs. of chlorine per twenty-four hours is located in the laboratory.

The metering equipment consists of two orifice type recording and integrating high service meters and one orifice type rate-of-flow indicator. Orifice plates for the high service meters are placed in the 16-in. high and low reservoir discharge lines just south of the pump station (Fig. in Part I). The meters have a maximum capacity of 5,000,000 gal. per day, with a normal rating of 3,000,000 gal. per day. The orifice type rate of flow recorder is placed in the 16-in. raw water line from the low service pumps. A guaranteed accuracy within 2 per cent for all rates of flow between maximum and 25 per ment of maximum is given for all meters.

Test borings made at the site of each of the reservoirs indicated an underlying strata of firm clay. In designing the reservoirs, having capacities of 4,000,000 and 3,600,000 gal. for the low level and high level systems respectively, the plan was to balance the cut and fill so that no excavated material would need to be taken from or to the site. However, in the case of the low level reservoir, it was found that with such a design the difference in normal water level of the new reservoir and the existing 1,000,000 gal. capacity reservoir would be only about 5 ft. Such a layout would require a float valve in the pipe line between the old and new structures. The installation of a float valve is costly and often gives considerable trouble in operation. Comparative estimates showed that the new reservoir could be lowered enough to float directly with the smaller reservoir at a lower cost than would be required to install a float valve. The boundaries of the site were limited so that it was found necessary to built a secondary berm to within 3 ft. of the top berm of the reservoir. The toe of the side slope was brought out to the property line. When the construction has been completed the secondary berm will be made into a city park. Fig. 2 shows a plan and section of the high level reservoir.

The inside slope of the reservoirs is 1.75 to 1 and the outside slope 1.5 to 1. The lining and general design of the high and low reservoirs is similar. The shape of each was made to conform in general with the contour and plan of the site. The side slopes and bottom are being constructed with a double layer of concrete slabs and with footing beams only at angles. Between the slabs is a layer of membrane waterproofing. After the footing beams have been constructed and mopped with two applications of a water-proofing compound, the first layer of slabs are poured. They are approximately sixteen feet square and are separated by 3-8 inch

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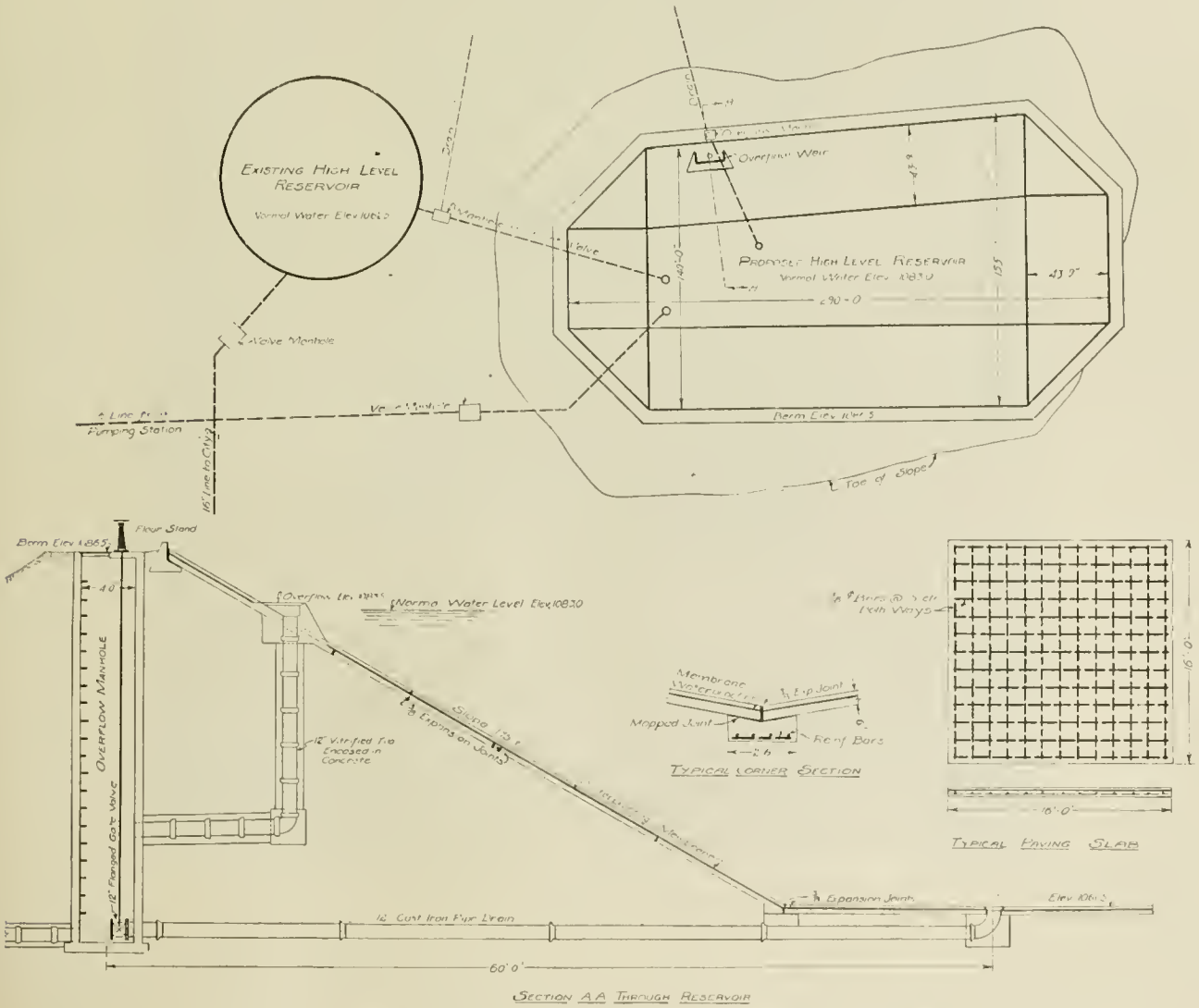
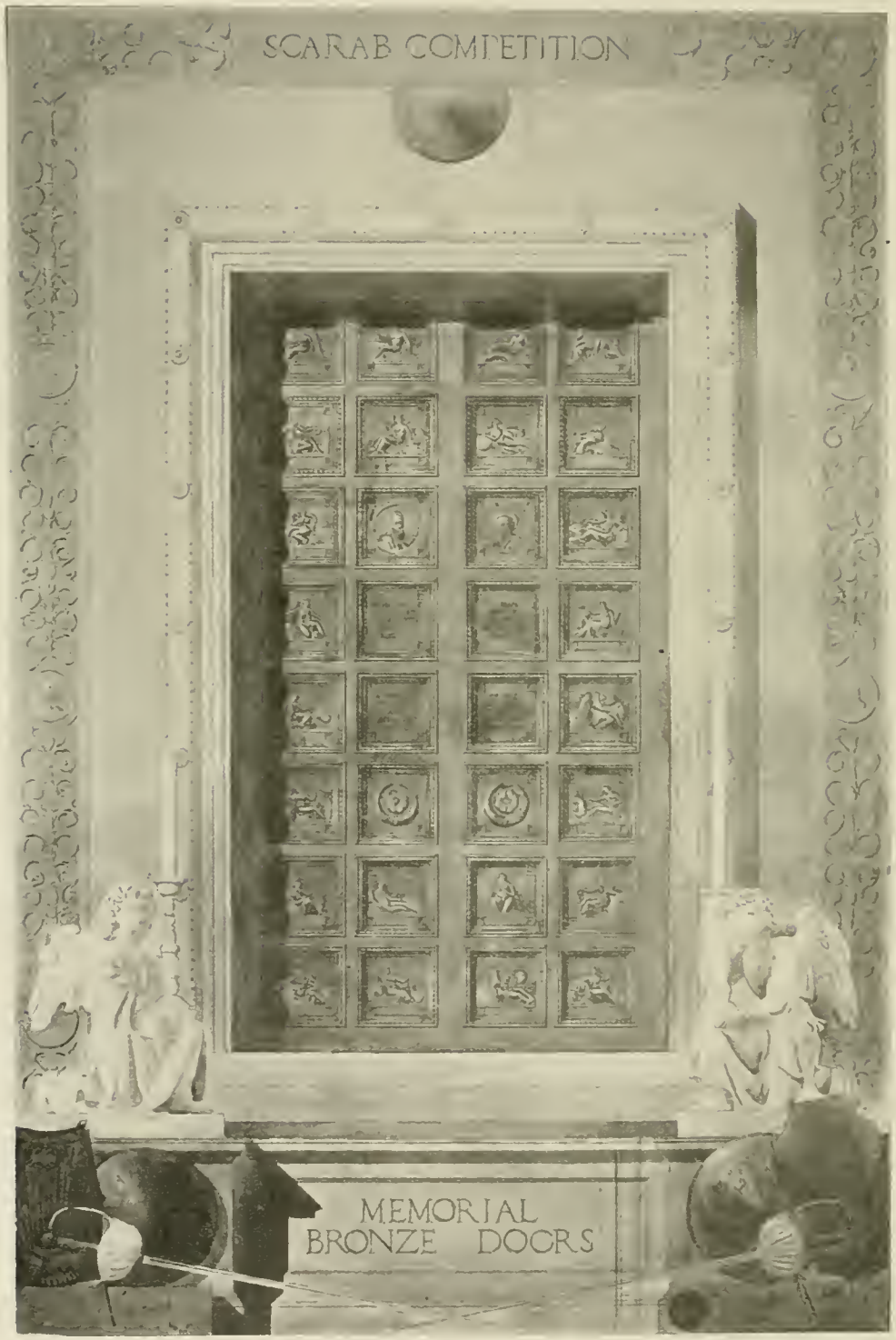


Fig. 2. Detailed Plan and Cross Section of High Level Reservoir



Scarab Medal

Oliver Stepan, '24

MEMORIAL BRONZE DOORS

The Value of Cultural Studies to the Engineer

R. E. Peterson, m.e., '25

This article was awarded first prize in a contest conducted by Tau Beta Pi.

During the fifteenth century great fortifications were being built in the Kingdom of Romagna. Vast throngs of brazen slaves labored on every hand. Over the ground rode a tall, stately man on horseback, followed by two slaves in a cart drawn by a bull. The very presence of this character lent dignity to the project. He was Italy's greatest pride —Leonardo da Vinci.

The Pope had chosen Leonardo to plan the fortifications and canals, to survey the tracts, and to engineer the project throughout. Leonardo carried a large sketch book and as he made plans for redoubts, he also made notes on the flight of birds, the movement of clouds, the musical tones in a water-fall, the habits of bees, and a hundred other topics. He was alive to the world about him.

Leonardo da Vinci was the greatest engineer of his time. His conceptions of mechanics were by far the soundest. His plans for building a canal from Pisa to Florence were carried out in detail two hundred years later. He placed a new foundation under a church which was sinking in the sand and elevated the whole structure several feet. But Leonardo was more than a brilliant engineer. His interests carried him beyond the bounds of technical narrowness. At the time that he was working at physics and mathematics, he was painting and modelling in clay for recreation. His progress in science and art was astounding.

While planning the great equestrian statue of Francisco Sporza, Leonardo dissected a horse and then wrote a treatise on the subject which is still a text book. Incidentally, he made discoveries which anticipated Darwin by three hundred years.

The Duke of Milan sent for Leonardo on one occasion as "the most accomplished harpist in Italy."

But, above all, the name of Leonardo da Vinci is immortal as one of the world's greatest artists. The famous "Last Supper" is known throughout the world. On the walls of the Louvre hangs "Mona Lisa" of Leonardo da Vinci. For four hundred years this picture has been an inspiration to every portrait painter who has put his brush to the canvas.

One of the obvious reasons for the brilliancy of Leonardo da Vinci was the freshness of mind which he possessed by virtue of his versatility. His vision was not fogged by the stagnant ideas of a one-compartment mind.

Men often possess the idea that they are born to do a certain thing well to the exclusion of everything else. Such an idea is erroneous. It is a psychological fact that men who are brilliant in one particular line are quite apt to be superior in other ways. Remarkable intellectual achievements in any line imply highly developed sense organs and intensive training of the capacity for thought and reasoning. Therefore, it is quite possible for the technical man to pursue cultural subjects with the same thoroughness with which he studies his problems. Leonardo da Vinci is typical of many others.

The noted F. Hopkinson Smith was once a novelist, painter, and engineer. Edgar Allen Poe possessed one of the keenest mathematical minds of his generation. The creator of "Alice in Wonderland" was none other than Charles Lutwidge Dodgson, brilliant writer and lecturer on mathematics. Benjamin Franklin,—scientist, inventor, author, statesman,—is a splendid example of a well-educated man. His wisdom and sound judgment were undoubtedly enriched by his versatility. A broad mental horizon enables the technical man to study subjects from various points of view. The engineer finds his scientific knowledge strengthened by the study of cultural subjects.

It is by imagination and vision that the engineer conceives the epoch-making ideas which accelerate the progress of civilization. Psychologically, imagination implies visual imagery. By studying history and literature, which carry the engineer far from his surroundings by the formation of vivid mental pictures, the capacity for visual imagery is strengthened. A fertile imagination enables the technical man to understand puzzling phenomena and comprehend abstract relations. Thus, a tremendous mental leverage for the solution of difficult problems is obtained. Ingenuity and resourcefullness go hand in hand in imagery. The value of a rich imagination cannot be overestimated.

Engineers must deal with men as well as with materials. Human relations exist in engineering as elsewhere. Many a budding engineer has been deprived of a high-salaried position because he could talk nothing but foot-pounds and B.t.u.'s. Cultural training camouflages the barrier of cold technical fact and makes the engineer a man among men.

But, after all, the greatest benefit accruing from cultural pursuits is an increase of appreciation and

(Continued on Page 166)

EDITORIAL

THE TECHNOGRAPH STAFF

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E. S. Foster, '25 ---------- Assistant Editor
L. R. Ludwig, '25 ---------- Assistant Editor
C. E. Parmelee, '25 ---------- Assistant Editor

Thomas L. Pankey, '24 ---------- *Business Manager*
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E. S. Foster, '25 ---------- Ceramic
H. E. Wessman, '24 ---------- Civil
G. G. Robinson, '24 ---------- Electrical
H. E. Butters, '25 ---------- Mining
L. R. Ludwig, '25 ---------- Railway

Will It be an Engineers' Dance?

This year the dance committee has decreed that the Engineers' Dance will be an engineers' dance, and not a hopeless assembly of so-called "campus snakes," and a few engineers. It is truly a worthwhile effort, but its success depends upon the response of the engineers. True, many engineers do not dance a great deal, but the Engineers' Dance is for engineers and they should make every effort to attend it.

When the ticket sale opens to the engineers, it would be a great experience to have all of the tickets sold out the first day.

An Honor System for Senior Engineers

During the recent semester examinations, we were impressed with one occurrence that seemed to characterize the seniors' examinations: namely, in each case they were conducted under a system much akin to the honor system. Of course, instructors were present in the room as required by the University ruling, but we would not call it a rigid proctor system of examinations.

The point to be made is this: the conducting of the examinations for seniors seems to indicate that the professors having them in charge feel that the honor system did not fail because of mistreatment by seniors. On the contrary, they have enough confidence and faith in the honor of the seniors that they conducted the examinations under a proctor system where personal honor was ones only proctor. This confidence is appreciated by all of the seniors, and we do not believe that it is misplaced. However, seniors are men who in another year will find themselves out in the world, with personal honor as their greatest asset. Would it not be reasonable to assume that probably the greatest recommendation of a man's personal honor would be the fact that his university trusted him on his honor during his senior year? We believe that it would.

As pointed out above, the seniors are practically on an honor system, but it is not known by that name and the outside world does not know of it. Perhaps we could have an honor system for seniors—a real honor system and known as such—if a number of seniors petitioned for it. Senior engineers, here is an opportunity for you to do something big before you leave your university.

The Engineers Before the Public

In the coming Engineers' Day, success, in so far as the rest of the campus and the general public is concerned, lies in the parade. In this event the engineering students will pass in review before the rest of the campus, and on their appearance the College of Engineering will be judged.

Due to the natural feeling of pride which exists in the various colleges, a performance by one is belittled and ridiculed by the others unless it is good and commands attention and admiration. If the engineering Parade is to be successful and bring honor to the college, it must be dignified in appearance and the floats must be worked up in the best possible manner. A mediocre float and careless actions will not "get by."

If the parade is to be engineering, it must embody the ideals of an engineer. An engineer is a methodical, carefully trained and accurate man. He likes beauty in everything and aims especially for neatness in his work. Therefore in the parade, things must move like clockwork, the floats must be objects of beauty, and the marching ranks must be parallel and properly spaced. These are the things people will look for in an engineering parade—they are the things people look for in an engineer.

The Student Branch of the A. A. E.

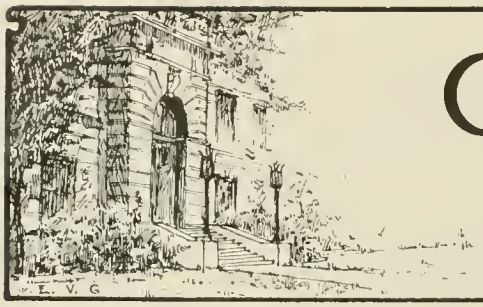
In the days when Dr. F. H. Newell was head of the Civil Engineering Department of the University, the student branch of the American Association of Engineers was the most active of the engineering societies. Today, it has reached the point where it must either reorganize and amount to something or surrender its charter. We hope that the latter alternative will be avoided, because we believe that the A. A. E. is a worthwhile organization and should be continued at Illinois.

Perhaps no other national engineering society has taken the public interest of the engineer to heart as has the A. A. E. It has actively supported the passage of engineers' license laws and has urged engineers to become active in public life. It maintains an employment bureau that is second to none, and it strives in every way to make the engineer satisfied in his work and protected in his profession. An organization with such ideals is worth belonging to and supporting, and it should be active here at Illinois. However, the chapter here has practically died out and the few remnants of it are not in any way an honest representation of the high ideals of the organization of which it is a part. The local officers of the society should either build up their chapter or destroy it—it should not go on as it is.

The Highway Short Course

In the opinion of many, this year's Highway Short Course was the most successful of the eleven annual meetings that have been held at the University. And it is not difficult to justify such an opinion. That the program was interesting and valuable is best attested by the fact that the morning and afternoon sessions of the five day meeting were crowded. Between three hundred and four hundred men were present in the lecture room each day, and took part in the discussions. Their presence and their interest indicates the value and importance of the papers and discussions, and is probably most indicative of the success of the Short Course. The Civil Engineering Department of the University and the State Division of Highways are to be congratulated on the valuable program that was presented, and on the hearty response that it received.

There is, however, an important aspect of the Short Course that is deserving of consideration by both the University and State officials. At present, there are no funds available which would permit the publication of the papers and discussions presented. Surely if the work covered is of sufficient value to bring several hundred men here from all parts of the state, it is of sufficient value that it should be published and made available to the hundreds who are not able to come for the Course. It would be a worthwhile achievement to secure funds for the publication of the Highway Short Course proceedings.



COLLEGE NOTES

Illinois First Engineers' Day

On Friday, April 4, the engineers will rest from their labors at 2:50 P. M., and participate in our first annual Engineers' Day. It has been hoped for some years that such a celebration could be staged, and next month will find that hope realized. It is an event that should be the largest of the year for all engineers, in as much as it is their one opportunity to get out and show the rest of the campus that engineers are something besides the slide rule artists and drafting room hermits that they seem to be in the illusioned minds south of Green Street. It will be something new to the campus to see a parade of approximately fifteen hundred engineers marching behind gaily decorated floats, and it is up to the engineers to see that the campus is pleased and impressed with their efforts. It is an absolute fact that as far as the rest of the campus is concerned, the success of Engineers' Day depends upon the success of the Engineering Parade. The parade will end at the Auditorium where the Engineering Assembly will be held. The faculty committee has secured Mr. C. E. Grunsky of San Francisco, California, to address the students. Probably, nowhere in the country is there a man who is more representative of the engineer than Mr. Grunsky. His career has been a series of marked achievements in a wide field of engineering. He has been city engineer of San Francisco, a member of the Isthmian Canal Commission, consulting engineer to the U. S. Reclamation Service, advisor to the Secretary of the Interior, and consulting engineer in New York and in San Francisco. Last January, he was elected president of the American Society of Civil Engineers. Mr. Grunsky is a finished speaker, and his address will be of interest to everyone.

C. E. Grunsky
Engineers' Day Speaker

At six o'clock the faculty will get together for their annual dinner with its accompanying merriment. It is expected that every member of the faculty will attend. Professor Benedict is making arrangements for the dinner, and Professor Moore who is taking care of the program promises some real entertainment. For the students the crowning event of the evening will be the Engineers' Dance. The committee is working hard to make the dance truly engineering, and the decorations and features will be worked out with this in mind. Arrangements have been made for the faculty dinner to end early enough so that the faculty may come to the dance if they so desire. It is hoped that they will attend in a body and make the affair not only a student engineers' dance, but a real engineers' dance. All of the arrangements for Engineers' Day have been worked out by Engineering Council through its various committees, and Dean Ketchum's faculty committee. The representatives on Engineering Council are: T. E. With, Chairman, mechanical engineer; W. E. Mueller, Secretary, electrical engineer; E. I. Harrison, architect; H. E. Herting, civil engineer; B. L. Lubelsky, mining engineer; C. C. Anderson, railway engineer; R. E. Rief, ceramic engineer; and J. R. Welsh, Technograph.

Dean Ketchum's faculty committee is: Professors E. C. Schmidt, Chairman; A. E. Drucker, H. H. Jordan, E. B. Paine, L. H. Provine, and C. C. Williams.

The Engineering Parade Committee is composed of H. E. Wessman, Chairman, and the following departmental committees:

Civil Engineering: E. C. Hartman, Chairman; W. K. Pierce, M. M. McClelland, M. L. Calvert, W.

H. Thoman, S. S. Ball, P. W. Joy, W. S. Fitzer, R. A. Niles, T. J. Hynds, G. A. Karlson, C. K. Moore and J. W. McKay.

Mechanical Engineering: I. L. Peterson, Chairman, J. L. Schaller, W. G. Roesch, B. G. Rich, G. L. DeMent, and W. H. McKee.

A. G. Dixon

Electrical Engineering: G. G. Robinson, Chairman, E. K. Shively, L. G. Warren, H. A. Bartling, R. C. Ballard, D. B. McCullough, and F. P. Moy.

Railway Engineering: C. E. Sperry, Chairman, E. R. Waring, W. J. Tietz, L. R. Ludwig, R. S. Watts, T. H. Plumleigh, R. A. Preston, and C. C. Anderson.

Architecture and Architectural Engineering: H. L. Brewer, Chairman, J. W. Gregg, H. W. Pfeiffer, J. D. Prouty, A. T. Gilman, A. Paulson, D. King, and W. I. Hanby.

Mining Engineering: C. H. Dodge, Chairman, B. L. Lubelsky, H. E. Butters, J. W. Schaefer, E. Bremen, and G. L. Smith.

Ceramic Engineering: E. S. Foster, Chairman, C. E. Parmelee, W. P. Whitney, and W. D. Kimmel.

Municipal and Sanitary Engineering: A. L. McCabe, C. B. Farrell, E. E. Lamp, H. A. Vagtborg, F. M. Williamson, J. C. Sagger, and C. T. Wright.

The Engineers' Dance Committee is composed of A. G. Dixon, Chairman; C. T. Parker, W. G. Kennedy, J. R. Scott, I. E. Boberg, H. E. Wessman, C. H. Dodge, W. E. Lyons, F. S. Markert, W. E. Armantrout, and J. R. Welsh.

Engineers in Activities

A. G. Dixon, g.e., '24, is another of those engineers not too busy to take an active interest in campus affairs. Art is senior director of the Illinois Union, a member of the Committee on Student Activities, president of Sigma Tau, Chairman of the Engineering Dance Committee, and holder of numerous other titles.

R. J. Rutherford, m.e., '24, is president of the senior class. Bud has been interested in the Illinois Union, was General Chairman of Homecoming, and House Manager of the Post Exam Jubilee.

John Trissal, r.e.e., '25, is active in Y. M. C. A. work, being a member of the building committee, and a worker on the recent European Relief Pledge Drive.

W. W. Lawrence, '24, is chairman of the History Committee of the Illinois Union. E. F. Sandhern, m.e., '26, is a member of the same committee.

C. L. Abney, cer.e., '25, the engineer-actor, is again prominent in the cast of "If."

A. W. Bruce, m.e., '25, and P. C. Dingley, g.e., '25, were workers of the European Relief Plus Committee.

C. S. Strike, m.e., '24, is chairman of the Senior Ball Committee. He is also, by the bye, engaged to Miss Ida Pellitt. R. A. Mattson, arch., '24, is also a member of the Senior Ball Committee, as are R. H. Louden, cer.e., '24, T. L. Pankey, m.e., '24, Harold Beedy, e.e., '24, F. W. Mueller, m.e., '24, and J. R. Scott, m.e., '24.

Nelson Sowers, e.e., '24, has been commissioned Lieutenant-Colonel in the Signal Corps.

P. R. Wilson, m.e., '25, is a Lieutenant-Colonel in the Artillery Unit.

The history which Prof. I. O. Baker has been writing of the College of Engineering is completed and in the hands of a committee to review it before publication. It is a complete history of the engineering school from the time of its installation until the present, including the introduction of new departments and courses and the research and experimental work which has been carried on. The history will be published as soon as it leaves the hands of the committee.

Engineering Debate Team

Thoman Wessman Johnson

Physics Research News

A number of the men in the physics department are working on some of the new scientific problems with remarkably good results. W. K. Smith is examining the dielectric constants of gases by the discharge method. Those constants have only recently become useful, and hence have not been scientifically determined. Mr. Smith is using a special commutator devised in the physics department for the charge and discharge of gases. Previous commutators have depended upon the principle of plunger contacts which has proven unsatisfactory. The new method consists of a revolving eccentric carrying a platinum contact. This gets away from

the difficulties presented by sliding contacts of the usual form. This work is the continuation of work which has been carried on before principally by Dr. E. C. Fritz who used it as a thesis subject in obtaining his Doctor's degree.

The convection of heat in liquids from hot wires is the subject of investigation by R. A. Nelson. The photographic method is being used, actual pictures being taken of the convection of the liquid due to its heating by hot wires.

Dr. Kunz and Prof. Tykociner are measuring the intensity of light with a new photo electric cell using caesium. It is much more sensitive than any previously developed cell.

Prof. C. T. Knipp is still actively engaged in the study of radio tubes. The alkali vapour tubes primed with the sodium potassium alloy is being tried out by both General Electric and Western Electric. Prof. Knipp recently made a trip to the University of Pennsylvania where the tubes were exhibited with much success. He then went to New York at the request of the Western Electric Co. to be present when the tubes were given a test. At both places there was much favorable comment on the action of the tubes. The breaking down of the machine for the production of liquid air has held up the work during the last semester. Liquid air is used to condense any vapour of mercury which might enter the tubes during exhaustion with the mercury vapour pump. Further temperature tests will be made on the tubes, as will spacing of the electrodes and the surfacing of the glass with the potassium sodium alloy.

The work of most intense interest regarding the tubes however, is the experiments being conducted with metallic caesium as a primer. The caesium is being prepared from its chloride by replacement with metallic calcium. Caesium is highly explosive and must be handled with great care. During the heating all air must be driven from the tube in which it is being prepared. The caesium is sealed in small capsules and placed in the tubes when ready. Mr. Brown of the E. E. Department who is also carrying on the work has recently secured a new quantity of tubes with which to work. The remainder of the year will be spent in finding the characteristics of these tubes and running their temperature tests.

Prof. Knipp has also been working with the fusing of base metals with glass. It has been found that plates, strips or tubes of copper may be fused with glass and the joint made air tight. The secret of the process is in sharpening the edges of the copper to a razor edge and carefully cleaning before attempting the fusion. Prof. Knipp has fused several pieces of copper with glass in the most successful manner. One of the advantages of this process is the possibility of joining ordinary glass with pyrex glass by using the copper as an intermediate connection and fusing each with the copper.

Fraternity Activities

Tau Beta Pi

Early in the semester Tau Beta Phi met, and elected the following officers for this term: President, G. G. Robinson; Secretary, G. W. Mattson; Treasurer, N. A. Tolch; Corresponding Secretary, J. W. Romig.

On February 23, the members took lunch together at the Southern Tea Room. These meetings seem to be quite popular with the faculty as well as with the students, and it is planned to hold more of them during the semester.

Theta Tau

At the regular meeting on January 10, 1924, the following officers were elected to guide the fraternity through the coming year: President, M. N. Quade; Vice President, W. K. Pierce; Secretary, R. J. Stockham; Treasurer, L. J. Simonich; and Corresponding Secretary, R. A. Seepe.

At the meeting held on February 14, at the Sigma Nu house, R. B. Sargeant gave an interesting talk on the subject of gasoline engines entitled, "More Miles per Gallon." On February 28, the second meeting of the semester was held at the Psi Upsilon house. A. J. Cope told the meeting of his experiences in Japan shortly after the earthquake. He arrived in Yokohama about a week after the disaster, so he was able to give an intimate and vivid description of the afflicted area.

Our Contemporaries

The University of Virginia is a pioneer in lengthening its engineering course from four years to five. The fifth year goes under the name of a graduate year but is required before the degree is given. This makes the degree conform to that of other universities. The schedule includes courses divided into three types, namely, humanities, mathematics and sciences, and technical engineering. The humanities include courses such as history, English literature and economics. The purpose of the five year curriculum is to provide for a larger number of this type of course and to give a greater degree of specilization in technical engineering. Some of the new courses introduced are cost accounting, history, survey of English literature, philosophy and fine arts, mathematics, and materials of construction.

(Continued on Page 154)

FROTH

A Virginia editor threatened to publish the name of a certain young man who was seen hugging and kissing a girl in the park unless his subscription to the paper was paid up in a week. Fifty-nine young men called and paid up the next day, while two even paid a year in advance.—*San Francisco Clarion.*

"Well, and what did you think of the beauties of the Maine woods?"

"Didn't see a single girl after leaving the depot!"

—*Judge*

Applicant: "I'm a college graduate."

Employer: "Well, I guess I'll give you a chance anyway."—*Life.*

First Deaf Mute: "He wasn't so very angry, was he?"

Second Deaf Mute: "He was so mad that the words he used almost blistered his fingers."

—*Indianapolis News.*

The more than usual lack of intelligence among the students that morning had got under the professor's skin.

"Class is dismissed," he said, exasperated, "please don't flap your ears as you pass out."

"That waitress made me mad this morning. She said to me, "Do you know how many waffles you have eaten already?"

"I said 'No,' and then she said, 'This makes the twenty-sixth'."

"Well it made me so mad, I just got up and went to class without my breakfast."

"Can anyone," asked the instructor, "give me a sentence using the word 'disarrange'?"

The first three students balked. Finally, her eyes lighted on Angelo.

"Angelo, can you give me a sentence?"

"Sure," said Angelo, "My poppa, he getta up disa morn' and he lighta da stove. She smoke. He say, 'Damma disa range'!"

HOW AN EDITOR GOT RICH

When he started he was as poor as the proverbial church mouse twenty years ago. Now he has retired, with a comfortable fortune of $50,000.

This money was acquired through industry, economy, conscientious effort to give full value, indomitable perseverance, and the death of an uncle, who left the editor $49,999.50.—*Empeco Paper News.*

A DEEP ONE

Two mining engineers were discussing deep mine shafts, and one had told in glowing terms about mines in which he had worked.

"Jump into my car and I'll show you a regular mine," said the other.

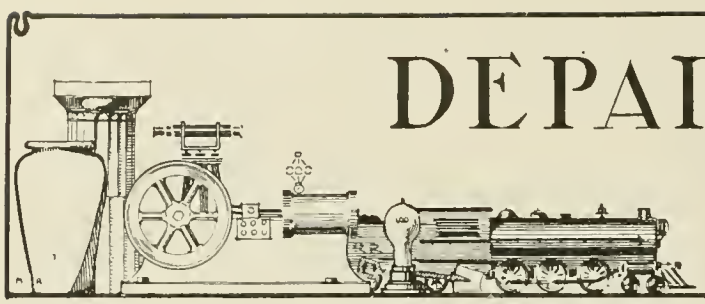
Arriving at the mine they saw the hoisting engine revolving at a terriffic rate. The engineman was asleep. Rushing to the sleeping man, they cried:

"Wake up, man! You'll pull the cage through the roof!"

"What day is this?" the engineman asked sleepily.

"It's Tuesday, but stop the engine quick!"

"Aw, g'wan," he replied, disgustedly, settling himself back in his chair. "She won't be up till Friday."—*Science and Invention.*



DEPARTMENTAL NOTES

Architectural News

Departmental Notes

The results obtained to date by the department in the Beaux Arts Institute of design work are pleasing. The last senior design problem, "A Cabaret," netted six first mentions and two second mentions. The men receiving first mentions were, Lang, Gallion, Harrison, Armantrout, Mattson, Kosvitch: In the junior problem, "A Candy Shop," the entire class received second mentions, while three sophomores, Wupper, Thomas, and Hedrick received first mentions on their problem, "A Family Tomb."

A. B. Gallion received a second mention in the first preliminary of the Plym Prize Competition, and although this does not place him in the next competition, it is quite an honor to receive an award in this competition. In the judgment of the Plym Preliminary, the following four out of the nineteen entries were placed in the final competition: E. V. Ganger, J. Bresee, J. Tutle and G. Keck. The final prize is $1,200, for one year's study in Europe.

Architectural Society

The Architectural Society is rapidly breaking away from the inaction caused by last semester exams. The Student-Faculty Banquet, the big affair of the year, was held on February 28. The Society was fortunate enough to obtain Mr. I. K. Pond as the main speaker for this banquet. The banquet is quite a drawing card in itself, and with the added attraction of a talk by Mr. Pond, the affair was an exceedingly interesting one.

Scarab

Scarab held its annual smoker at the Chi Psi house on February 12. Messrs. Dillenback, Pickering and Bailey cast pearls of wisdom and told several jokes. Orm Lyman livened up the entertainment with several warm numbers on the piano. So when all is said and done, Scarab earned the right to place another successful smoker on its record.

Ceramic News

American Ceramic Society

January 10 marked the close of a very active semester for the Student Branch of the American Ceramic Society.

The last meeting was held at the Illinois Union Building. G. S. Smallwood presided, for the last time, with his usual vigor. Jack's departure from the ceramic school, at the end of last semester, was due to graduation.

The meeting opened with an interesting talk by Dr. P. H. Brown, of the economics department, on "The Size of Corporations." Then the usual ceramic pep came to the fore. The Phi Pi Phi orchestra played some popular selections and by request, R. H. Weston, '24, entertained with a song and a dance. Weston's part of the program was said to be a replica of the inspection trip entertainment. After the music had subsided, two of Paul Prehn's pugilists, Nacelli and Marzulo, put on a fast three-round boxing exhibition.

The meeting broke up after a plentiful supply of milk and cake had been consumed.

Departmental Notes

An exceptionally good collection of pottery, made by ceramic students last semester, is on display in the Ricker Library. The quality of this display is partially due to the keen competition displayed among the seniors, in turning out new glazes and new styles of pottery.

The Ceramic Short Course

The Ceramic Short Course proved to be a greater success than ever, this year.

The registrants assembled from twelve states, namely, Alabama, Colorado, California, Indiana, Missouri, Ohio, Pennyslvania, Tennessee, Texas, Kentucky, Wisconsin and Illinois.

The course was conducted in a slightly different manner this year. For example, the work of the Short Course was so divided as to be of special interest to every attendant. The lectures on bodies and

glazes were of especial interest to those interested in pottery production. The men interested in enamels were handled separately.

Besides the faculty of the ceramic department and many other lecturers from the College of Engineering, there were three visiting lecturers. Professor Watts, head of the ceramic department at Ohio State, lectured on "Ceramic Bodies"; R. M. Howe, of the Kier Fire Brick Company, spoke on "Refractories"; and R. R. Danielson, from the Bureau of Standards at Washington, spoke on "Metal Enamels."

After a very successful Short Course, the ceramic department must now settle down for another two year wait, before a repetition.

Civil Engineering News

Departmental Notes

On Monday, February 4, the subcommittee of the Committee on Iron and Steel Structures from the American Railway Engineering Association met with Prof. W. M. Wilson, who is conducting the research on stress distribution in large segmental rollers applicable to movable bridges.

The civil engineering department is beginning a co-operative investigation with the U. S. Bureau of Public Roads, on "Drainage Factors for Illinois Conditions." C. E. Ramser, '09, is the senior drainage engineer in charge of the work for the United States Government. He will be assisted by H. J. Bartz, also of the U. S. Bureau of Public Roads, who will be stationed here with an office in the University. Prof. G. W. Pickels will have charge of the work for the Engineering Experiment Station.

Prof. W. M. Wilson is continuing his investigation on "Road Oils." The tests are being carried out on a 6-mile stretch of road extending south of Urbana. The stretch has been divided into a number of sections, each being treated differently. The more successful methods of treatment as revealed by the previous year's study on a 12-mile experimental road are being used on this new stretch. This road has come through the winter in good condition and a number of important conclusions have already been reached.

Dean M. S. Ketchum is teaching a graduate course, C. E. 125, this semester. It is entitled, "Advanced Design of Industrial Structures." The design of factory buildings, mine structures, etc., as affected by their particular function, and the relative economy of different types of buildings are offered in this course. Dean Ketchum's long experience in design of such structures, as Contracting Manager for the American Bridge Company and as consulting engineer makes this course of particular value to graduate students.

Am. Soc. C. E. Activities

On January 10, Mr. C. F. Stern, Consulting Engineer, Chicago, Ill., appeared before the Student Branch of the American Society of Civil Engineers and gave an interesting talk on the "Making of an Engineer." Some of the high lights of his address are as follows:

"The engineer in these days is accepted as a man of intelligence; 25 years ago was considered only a high grade draftsman. It is up to the student to acquire the right perspective as soon as possible. The graduate engineer who hopes to do big things eventually in his field must imitate the surgeon who goes through a period of hospital training. He, the engineer, must work for other people also before he sets up in business for himself."

"I admire a lazy man who is so lazy that he tries to find an easier way to do his work or a lazy man who works hard to get his work done so that he can indulge completely his faculty of laziness."

"If you cannot direct men you have no business being an engineer."

"If an engineer hasn't "guts," he had better get out of the profession; he will not succeed. Furthermore, he must have ideals. He must know how to sell his services, for if he wants a job he must be able to convince his employer that he is the best man for the job."

In closing his talk, Mr. Stern emphasized the value of acquiring perspective.

On January 17, a business meeting was held at which the following men were chosen to direct the destinies of the organization for the coming semester: President, H. E. Herting, '24; Vice President, H. E. Wessman, '24; Secretary, M. N. Quade, '25; and Treasurer, D. W. McGlashon, '25.

Remarkable interest is being displayed in the society and in its work, and the new semester promises well. One interesting meeting has already been held. On February 13, Prof. A. N. Talbot gave an illustrated talk on the subject, "Some Achievements of Civil Engineering Graduates, from 1871 to 1900." Pictures of the graduates to whom he referred and scenes of some of their notable works were flashed upon the screen. Some of the most notable men mentioned were:

J. A. Ockerson, '73, who is now chariman of 5 Standing Committees on the Mississippi River Commission:

Prof. I. O. Baker, '74, who was Head of the Civil Engineering Department at the University of Illinois for so many years:

August Ziesing, '78, President, American Bridge Co.;

Frank White, '80, now Treasurer of the United States;

Lincoln Bush, '88, who is famous for his work on the Tunkhannock Viaduct and his design of train sheds;

M. S. Ketchum, '95, now Dean of our Engineering College;

F. L. Thompson, '96, now chief Engineer of the I. C. R. R.;

G. J. Ray, '98, Chief Engineer of the D. L. & W. R. R.

Needless to say, Professor Talbot's talk was very interesting, especially to those of us who hope that some day, we may also bring credit to our Alma Mater even as those who have gone ahead of us have done.

President Herting has appointed E. C. Hartmann, '24, as Chairman of the Committee to arrange for the civil engineer's float in the Engineering Parade to be held on April 4. The other members of the committee are W. K. Pierce, M. M. McClelland, M. L. Calvert, W. H. Thoman, S. S. Ball, P. W. Joy, W. S. Fitzer, R. A. Niles, G. A. Karlson, C. K. Moore, and J. W. McKay.

Student members of the Am. Soc. C. E. arranged the program for the Highway Short Course Dinner at the Urbana-Lincoln Hotel, Thursday night, February 21. J. Robert Welsh led the community singing, the Triangle orchestra furnished the music, Brownlee and Brooks gave an exhibition of the ancient art of fencing, and E. V. Johnson and H. E. Wessman gave a joint reading.

A meeting of the members of the American Society of Civil Engineers from this vicinity, held at the Urbana-Lincoln Hotel on January 10, resulted in the formation of the Central Illinois Section of the American Society of Civil Engineers. The organization has been approved by the Board of Directors of the National Society. Prof. C. C. Williams has been elected Temporary Chairman, and Prof. C. C. Wiley, Temporary Secretary. Ballots have been issued for election of permanent officers.

C² Williams "A Seein' Things"

Prof. C. C. Williams, head of the civil engineering department, recently read a humorous paper before a meeting of the staff of his department. The title of the paper was "The Haunted House," and it described, vividly, some imagined hair-raising and blood-chilling encounters with horribly distorted spirits in the old boiler house. It seems that the spirits haunted Prof. Williams each time that he came to the new civil engineering laboratory, and began to prey on him mind. Finally, however, on Christmas Eve an elf came to him as he strolled through the building, and told him that the horribly distorted figures that he had seen were forms of True Theory that sought refuge from their sufferings in the new research laboratory. True Theory, according to the elf, has been so terribly twisted and deformed by Opinion and Committee Action that it must be untangled and revealed; hence its refuge in the new laboratory.

Chi Epsilon Activities

Chi Epsilon finished last semester's work with a meeting at the Beta Lambda house, Wednesday evening, January 9. At this time the following officers were elected and installed: President, E. C. Hartmann, '24; Vice President, W. H. Thoman, '24; Secretary, M. N. Quade, '25; and Treasurer, C. V. Erickson, '25.

The first meeting of the present semester, held Monday afternoon, February 11, was indicative of an active and interesting program for the rest of the year.

Electrical Engineering News

E. E. Society

The end of the first semester found the E. E. Society with a full program ahead. The last meeting of the semester was spent in a discussion of the coming E. E. Show. C. T. Parker, General Manager, told of the general progress so far, after which G. G. Robinson, Chief Engineer, explained the stunts which are being worked up by the students of the department.

At this meeting also, the officers for the second semester were elected. The officers are: President, W. E. Mueller; Vice President, L. A. Mollman; Secretary, W. G. Kennedy; Treasurer, J. T. Jackson.

The new officers started the semester with one of the celebrated E. E. feeds, on the Friday night after registration. Prof. Paine spoke about the E. E. Show and the things necessary for its success. Prof. Knight then spoke on "Co-operation" and succeeded in inspiring everyone present. The current news of the Electrical Show was then presented, after which the meeting adjourned to the "eats." The committee had worked well and there was enough cake, apples, and pop so that everyone had "seconds" at least.

The E. E. Department will be represented in the Engineers' Day Parade with a float which should be among the best. The committee which is composed of G. G. Robinson, '24; E. K. Shively, '24; L. G. Warren, '24; R. C. Ballard, '25; H. G. Bartling, '25; D. B. McCullough, '26; and F. P. Morf, '26, is already hard at work.

The E. E. Department is glad to welcome Mr.

Frank C. Mock, who comes here from General Electric Company, as an Instructor in E. E. He received his Bachelor's Degree at Columbia and his Master's Degree at the University of Michigan. For the last five years Mr. Mock has been connected with the General Electric Company.

Prof. A. R. Knight and Mr. M. A. Faucett of the department staff have been conducting a series of tests on single and polyphase watthour meters during the past few months, to determine the change in registration with change of temperature. The tests have been carried out for power factors of unity, .5 lag and .5 lead, with temperatures ranging from 25 degrees C. to 100 degrees C. The results so far indicate but little change in registration for .5 power factor. At unity power factor, however, the meters seem to have a positive coefficient of about .06 per cent per degree Centigrade rise in temperature.

Prof. Knight and G. G. Robinson, '24, have begun an investigation with a view of studying the transients in series circuits. The problem was suggested by the fact that the life of incandescent lamps used in street lighting seems to depend on the number of switching operations rather than the hours of use.

Radio News

The University Station, WRM, has been broadcasting all of Illinois' home basketball games in addition to musical concerts and lectures. More people seem to listen for the reports of games as indicated by the cards received. In broadcasting the basketball games, the announcer, who is located in the press box, uses two microphones. One is an airplane microphone which is designed to cut out propeller and engine noises; the other phone is of the ordinary type. In describing the plays the announcer uses the airplane microphone, and to get the cheers and applause he uses the ordinary phone. Many old Illini seem to enjoy the yells.

At the Ohio game a new method of modulation was used with fairly good results. This method causes the antenna to radiate only when the announcer is speaking. This method has been tried before but has not been very successful, due to distortion. As used here, it has been modified and promises to be satisfactory.

Mr. H. A. Brown and Mr. C. A. Keener, of the department staff, are just finishing some research of the modulation secured by different methods. Some of the systems of modulation which have been tested are: constant current, power amplifier, grid leak, direct modulation on grid (Logwood's system), and constant potential modulation.

Out-door Substation. The outdoor substation to the north of the laboratory is now in place. It has been installed on a concrete platform which is large enough to support the framework for handling the lead-in wires. Three 15 Kva. single phase, 33,000-2,300 volt transformers are inside of this framework. Protection is obtained by the use of oxide film lightning arrestors.

Lecture by Mr. Mills. "Electrical Investigations of Speech and Audition" was the title of an interesting lecture given February 15, 1921, by Mr. John Mills, of the Western Electric Company. Mr. Mills is well known as he has written several books on radio which were used during the war. "Within the Atom" and "Letters of a Radio Engineer to His Son" are also among the books he has written. This lecture was illustrated by three reels of motion pictures and showed how electrical speech transmission is used in the study of audition. The use of electricity makes it possible to carry on the study and vary only one thing at a time. That is, certain definite frequencies may be cut out and the effect noted.

The lecture and films showed how sound waves are transmitted electrically. In this connection the formation of a compound wave was demonstrated graphically. The experiments in audition have been carried out with a laboratory telephone consisting of a condenser, transmitter, three stage amplifier, potentiometer, filters and the telephone receivers. Some of the results showed that elimination of frequencies below 1,000 gave 84 per cent articulation while elimination of those below 2,000 and 3,000 gave 42 and 12 per cent articulation, respectively. The results also showed that 4/5 of the speech energy is carried by frequencies below 1,000 cycles. The different vocal sounds also differ in reception as shown by the fact that "a" can be recognized nearly 100 per cent of the time over a wide range of loudness; while "f" can be recognized only 88 per cent of the time over a narrow range. Normal audition uses from 20 to 20,000 cycles per second with the interesting fact that the low frequencies carry most energy while the higher frequencies give greater clearness.

Eta Kappa Nu Activities

Eta Kappa Nu, honorary Electrical Engineering fraternity, continued the custom which it re-established last year, of presenting a handbook to the E. E. Sophomore who received the highest grades during his freshmen year. H. Beedy presented the handbook to W. E. Lynch, '26, at the first meeting of the E. E. Society this semester. Mr. Lynch's average during his first year was 4.8.

The officers for this semester are: President, H. U. Arning; Vice President, W. H. Clingman; Secretary, H. A. Bernreuter; Treasurer, L. A. Mollman; and Sergeant-at-Arms, W. G. Kennedy.

Mining Engineering News

Departmental Notes

Several changes in the mining curriculum have been sanctioned by the University. These will go into effect next year and should manifestly improve the schedule. Mine surveying will be given in the Sophomore year instead of in the Junior year. This will aid the men in obtaining summer employment and will allow Mining 1, elementary mining methods, to be put into the Junior year, where it will closely precede Mining 4, advanced mining methods. Heretofore, too great a lapse of time has been allowed between these two similar courses. Geology 20 is to be replaced by Geology 47. While both are courses in mineralogy, Geology 47 is felt to be more nearly what is needed by mining engineering students. There will be no changes in the number of hours in any semester.

It is expected that the United States Bureau of Mines will send a mine-rescue car to the University again next year to give the same courses in mine-rescue and first-aid work as were given last November. Next year, however, the car will be here between semesters so that no time need be lost from the regular work in taking these courses. A number of men are expected to avail themselves of this opportunity.

Don Buchanan is back in school this semester, picking up his work where he left off. Don was out one semester because of sickness. J. H. Setinsky underwent a major operation at the Mayo Brothers' Hospital between semesters and will not be able to attend school this year. He has the best wishes of the entire mining department for his speedy recovery.

A text upon which Prof. Drucker has been working will be combined with a book that Prof. Fraser has been writing and will be published as one volume entitled, "The Economics of Ore and Coal Preparation." A contract for its publication has been entered into with John Wiley and Sons, of New York. Judging from their letters, the publishers were desirous of securing the contract after having obtained the opinions of several prominent educaters and engineers as to its worth. These men unanimously believed that the book will offer a connecting link between practical mining and the economics of mining. In the preface to Part I of the book, its purpose is summed up in two paragraphs, as follows:

"The metallurgical engineer must know not only plant designing, the methods of ore reduction, the action, operation and limitations of all metallurgical machinery, but most important of all he should be able to interpret these in terms of financial efficiencies and maximum profits. He will then be in a position to safely select and advise on all processes.

"Therefore it is the purpose of this volume to give engineering students sufficient problems of this nature to enable them to think logically along possible lines for the future. Such problems should teach students to become self-reliant in the application of the principles of metallurgy to engineering economics."

The book will be used by Prof. Drucker in his classes in Mining 17B and by Mr. Smith in Mining 13.

Mr. Fraser, Mr. Smith, and Mr. Moses are often absent over the week-ends in connection with research work on problems in mine ventilation. During the week they work in the laboratory obtaining theoretical results and during week-ends they go into various coal mines of the state and apply these theories. In this way, work of practical value may be done, and constants may be derived that will aid in the solution of mine ventilation problems, which at present, cannot be accurately solved because of inaccurate formulae. Their first work was done in the Benson mine in eastern Illinois. This mine was chosen because it is strictly modern and has the simplest systems of air currents. More difficult problems will be undertaken as the work progresses. The results of this work may eventually be published in bulletin form by the Engineering Experiment Station.

For the man who loves adventure, mining engineering holds a great lure. Witness a letter from P. N. Ferguson, '23, to Prof. Drucker. Mr. Ferguson accepted a position in Columbia, South America, immediately after graduation, and here is the contents of his letter:

"We left New York October 18 on the Grace line and changed to another ship at Colon. We had two days there to see the place, after which we left for Buenaventura, 10 hours from Panama. We spent two days at Buenaventura and two more going up the San Juan River on a steamer to the place where we turned up the Condoto River. We changed again here and finally made the last half-day by canoe."

"The company is putting in a new hydro-electric plant on the other side of the mountains, from which they are to get power for their dredges. I have been talking to the engineer in charge, and they need a man. If I can get a transfer I am going to work on that after the first of the year. I think I can make the transfer as the chief engineer is giving me a strong recommendation. I hope I get it as it means a job of responsibility, lots of experience, and incidently quite a substantial increase in salary."

Mining Society

The open meeting of the Mining Society,, held in 100 Commerce Building the evening of Wednesday, January 16, was addressed by Dr. Berman, of the department of economics, College of Commerce. Dr. Berman described the organization of the United Mine Workers of America, detailing the beginning, growth and purposes. He told of the many evils enforced on mining labor during early stages in the development of our metal and coal mining industries; how the laborers banded themselves together and succeeded in legislating out many of these evils or in forcing the operators to accede to humane treatment of their employees.

At the close of the meeting, the election of officers for the ensuing semester was held. B. L. Lubelsky was elected president; L. A. Moses, vice-president; and H. E. Butters, secretary-treasurer. President Lubelsky, in his acceptance speech, assured the members of a live, progressive program for the spring semester, including smokers and culminating in the annual Mining Society banquet in May.

Railway News

Sigma Epsilon

The Railway school has started the year by organizing an Honorary Railway Fraternity, incorporated under the name of Sigma Epsilon. It is the first Railway Fraternity in the United States, and may be followed by other chapters. In the first week of October permission was obtained from the Council of Administration to complete the organization which started with seven charter members including E. C. Schmidt, head of the Railway Department, as Honorary Member. The design of the key, incorporation and election of officers followed. The officers are: President, W. J. Tietz; Vice President, C. C. Anderson; Secretary and Treasurer, C. W. Wolf. The key resembles the cross-section of a standard rail with the Sigma and Epsilon engraved upon it. The other charter members were C. E. Sperry, F. C. Lindvall, and G. W. Lyons.

Sigma Epsilon is offering a handbook to the railway engineer who submits the best suggestion for the railway float to be a part of the parade on Engineers' Day, April 4. Suggestions must be given to the organization not later than March 15. The handbook will be the Standard for Electrical Engineers if an E. E. wins or the Marks for the winner if he is in the mechanical department. The civil would receive the Civil Engineers' Handbook. The actual float will be built by the men in the department through both the Railway Club and Sigma Epsilon.

The Railway Club has elected the following officers for the ensuing semester: President, C. C. Anderson; Vice President, R. S. Watts; and Secretary-Treasurer, R. A. Preston. It is the plan of the Club to hold regular meetings every second Thursday night presenting some form of program, either alone or in conjunction with some other campus organization. Participation in the Railway Float will be a good part of the immediate work to be performed. C. E. Sperry is Chairman of the committee which will have general charge of the Railway part of the Engineers' Day celebration.

Departmental Notes

Mr. Parkinson of the Railway Department is setting up air brake equipment to be used in conjunction with the courses in railway mechanical engineering, particularly R. E. 4. The apparatus will include some of the older equipment of "straight air" down to the latest locomotive, passenger car and freight car types. This will have considerable historical value as well as value for instructional purposes. Some of the equipment will be New York and some will be Westinghouse. The type K freight car layout will be used, and the modern ET locomotive equipment will also be set up. It will be possible to demonstrate completely the theory and practice as well as maintenence of air brakes and their accessory devices. Some new apparatus will be ordered soon. The entire assembly will be placed on the balcony in the locomotive laboratory.

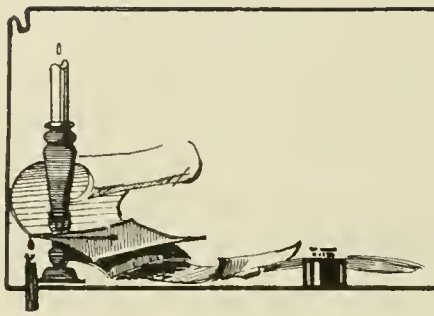
Mr. A. M. Buck, formerly Assistant Professor of Electrical Railway Engineering at the University and author of the text used in several of the courses at the present time is now Associate Editor of the "Electrical Railway Journal."

Prof. King is teaching this semester, a new course, R. E. 33A, which is proving of interest to the men of other departments. It is an abbreviated course in Economics of Railway Location, and is the outcome of R. E. 33, the same course offered to the men in the Railway Department. The present enrollment is made up mainly of Civil Engineers in the senior class.

The testing of rail joints which has been performed by Prof. Tuthill is complete. At the time of the article appearing in the Technograph about one-half of the test had been performed. Many widely varying forms of joint have been broken under the drop hammer near the power plant.

The locomotive testing plant is being enlarged to accommodate larger units. The work will be complete this spring, thus allowing for tests of performance of locomotives having eight or ten drivers.

Prof. Schmidt has attended a committee meeting on the Breaking of Rail Joints, and another on the Tests of Train Resistance at High Speeds.



ALUMNI NOTES

Many old Illini are with the Standard Oil Co. At Whiting in the sales department, are *R. J. Stercuson*, m.e., '23; *H. D. Rosendale*, m.e., '22; *Carl Küstner*, m.e., 23; *J. W. Peterson*, m.e., '23; and *R. E. Vogel*, m.e., '23; *G. K. Squier*, m.e., '17; *E. J. Bohnen*, m.e., '23; and *Russel Wharton*, c.e., '22, are also in the same department but at Chicago. *Don Monro*, m.e., '22, and *W. B. Mather*, m.e., '22 are in the drafting department at Whiting.

P. C. Peef, m.e., '23, is with the Worthington Pump and Machinery Corp., of Cambridge, Mass. He is employed in the department of Diesel engine design.

Carl James, c.e., '07, is assistant chief engineer for the Alabama Power Co., at Birmingham. Carl is in charge of extensive construction of hydro-electric power developments.

W. H. Jackson, min.e., '23, is assistant mining engineer for the United Verdi Copper Co., of Arizona.

Jack Comstock, min.e., '23, is with the Western Electric Co., at Chicago.

Everett G. Young, ry.m.e., '13, who in 1916 received the Master of Science degree has terminated his contract as Professor of Railway Mechanical Engineering at Nanyang University of Shanghai, China. He will return to America in June.

George J. Ray, c.e., '98, is now chief engineer for the L. & W. R. R. He will be the new president of the American Railway Engineering Association as he is the only candidate nominated.

John H. Anderson, c.e., '14, superintendent of construction for the H. F. Culbertson Co., Cleveland, Ohio, visited the campus recently. He is in charge of a four million dollar track elevation job at Cleveland.

Ira W. Fisk, e.e., '09, has resigned as instructor at the University of West Virginia and is now with John Biehler, Consulting Engineer, of New York. He is engaged in special investigation of street railway problems.

R. E. Lawrence, cer.e., '22, recently announced his marriage. He is with the Beaver Falls Art Tile Co., at Beaver Falls, Pa., together with *V. K. Haldeman*, cer.e., '23, and *G. E. Sladek*, cer.e., '17.

R. S. Bradley, cer.e., ('23), is now at Mexico, Mo., with a Fire Brick Co. He was at the University for the second week of the Ceramics Short Course.

M. Nakayama, e.e., '17, and *S. Taketa*, e.e., '15, are candidates for the professional degree of Electrical Engineer. They are engaged in hydro-electric development near Tokyo, Japan. They both were in the affected region at the time of the recent catastrophe.

G. W. Larson, c.e., '23, is with E. C. L. Wagner, Consulting Engineers at Kansas City, Mo.

C. A. Hughes, c.e., '06, is assistant engineer of the Missouri Pacific R. R. at Kansas City, Mo.

Alfred P. Poorman, e.e., '07, Professor of Mechanics at Purdue, has recently revised his book "Applied Mechanics." The sale of the first edition was remarkable and the new edition promises even more.

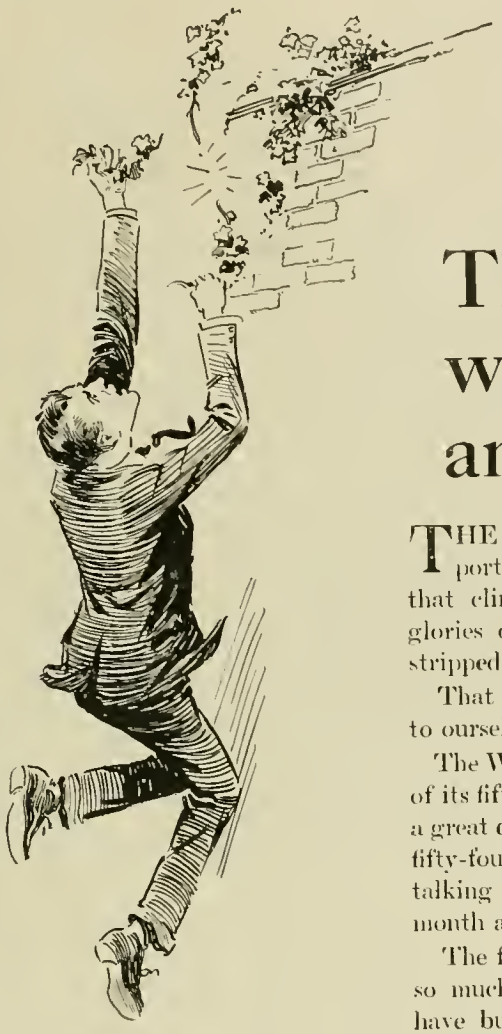
Arthur B. Durham, m.e., '23, is with the department of industrial engineering of the Joseph T. Ryerson & Son Co., at Kenilworth, Illinois. He is engaged in standardization of piece work.

John K. Holmes, m.e., '23, is maintaining the Illinois reputation against the assaults of Michigan, Rose and Purdue men at Marion Crane Co., of Marion, Ohio. He is in the engineering department and states that his work varies from electrical engineering to heating and ventilating.

C. E. Ksiazek, m.e., '23, has changed his name to 'Kazek'. He is assistant superintendent of the gas, water and light plants for the Southern Illinois Gas Co. He states that he will visit the campus the latter part of February.

E. J. Mehren, c.e., '06, has resigned as editor of the *Engineering News Record* to devote his full time to his duties as vice-president of the McGraw-Hill Publishing Company.

T. D. Owens, e.e., '20, is an instructor of electrical engineering at the Case School of Applied Science of Cleveland.



The ivy won't save any of us

THE ivy of tradition is a slender support. A man or a team or a college that clings to it, harking back to the glories of yesterday, is likely to be outstripped by some young but sturdy rival.

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P. Junkersfeld, e.e., '95, is a member of the firm *McClellan and Junkersfeld*, Engineering and Construction Co., New York. They recently moved their offices to 68 Trinity Place, New York City.

M. S. Leeming, ry.e.e., '22, is testing engineer for the Commonwealth Edison Co., Chicago.

T. S. Chow, ry.e.e., '23, has returned to Manchuria, China, where he has a position with a government railroad. His brother, *C. M. Tsau*, ry.e.e., '22, is with the city engineering department of Canton, China.

C. H. Tornquist, e.e., '06, is with the Phoenix Utility Co. He is engaged in the construction of a dam and power house on Bear River, near Alexander, Idaho.

E. E. Newcomb, a.e., '21, is with the firm of E. T. Hutchens, Architects, at Louisville, Kentucky.

W. B. Livesay, a.e., '14, and *N. E. Wiedemann*, arch., '20, are in business together under the firm name of *Livesay and Wiedemann*. They are located at Bomont, Texas, and state that business is good and they are working overtime.

Walter B. Worsham, e.e., ('11), is with the Illinois State Division of Highways in the Department of Public Works and Buildings.

E. H. Allison, min.e., '22, has opened a consulting engineering office at 105 W. Monroe, Chicago, Ill.

C. C. Hubbart, min.e., '15, is chief engineer for the Superior Coal Company at Gillespie, Ill.

L. W. Huber, min.e., '21, is employed by the B. F. Sturtevant Company of Chicago as an expert in their Mine Ventilation Equipment Department.

Preparation of Lumber from Logs in a Sawmill

(Continued from Page 122)

the material. The kilns are structures built of concrete, in which the lumber is placed and subjected to heat treatment. Steam pipes passing beneath the buildings supply the heat. The material is piled uniformly on trucks with spaces between the layers at regular intervals to allow the heated air currents to circulate freely amongst the lumber. The trucks carrying 2,200 board feet of lumber are driven on tracks into the kiln, each kiln being built to receive twenty-seven such loaded trucks for one heat treatment. At present there are twenty-six kilns in operation and twenty-six more are being constructed to accommodate 9,000,000 board feet of lumber being cut per month at the Ford mill. Covering a tract of land three hundred sixty by one hundred twenty-five feet, the Ford sawmill presents the most modern structure erected for the purpose of carrying on the work of the lumber industry.

A New Waterworks for Lewiston, Idaho

(Continued from Page 135)

expansion joints. All joints are filled with an asphalt expansion joint filler.

The surface of the concrete base-slab is thoroughly brushed with a specially prepared primer material to absorb all dust and saturate the surface of the concrete to insure a good bond between the concrete and base coating for the water-proofing membrane. About ten pounds of primer is required per hundred square feet of surface. The entire surface of the reservoir is then mopped with an asphaltic water-proofing compound, using about twenty-five pounds of material per hundred square feet. On this is embedded a high grade burlap saturated with water-proofing compound. Another mopping of asphaltic compound is applied after the fabric is in place. In this is embedded another layer of the fabric placed to break joints with the layer below, and a final mopping of asphaltic compound is applied in the amount used before. The top slabs or blanket layer are poured to break joints with the base slab. Enough steel is embedded in the base slab to provide for temperature variations. The base slabs are 4 in. thick and the blanket layer is 2 in. thick.

The principal items in the cost of the reservoir are 26,000 cu. yds. of excavation, 1,990 cu. yds. of concrete, and 30 tons of reinforcing steel. The purification plant requires 10,300 cu. yds. of excavation, 2,025 cu. yds. of concrete, and 103 tons of reinforcing steel.

The Short Course in Highway Enginering

(Continued from Page 128)

is justified in reducing grades and cutting down distance on our trunkline highways. In addition he pointed out that the fuel costs for motor vehicles was appreciably lowered on smooth pavements than on those of only fair condition. In fact, the fuel costs on a road of very smooth concrete are 20 to 25 per cent less than on a road of average workmanship. He therefore came to the conclusion that considerable expense was justified in securing a higher degree of smoothness on our paved roads than is ordinarily attained.

THIS, HORATIO, WE MUST PRINT

Lorna (after riding for three hours): "Don't you ever stop to look at your engine?"

Doone: "Oh, no. This is a Packard, you know."

—*Maltcaser.*

NOUVELLE BIBLIOTHÈQUE DE L'UNIVERSITÉ DE LOUVAIN
LOUVAIN BELGIQUE
WARREN AND WETMORE ARCHITECTES
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THE Louvain University Library is the testimonial of 1,000,000 American students to their fellow students in Belgium and a memorial to the American students who gave their lives in the great war. It is one of the fine buildings on which The Foundation Company, as general contractor, is rendering complete and efficient service.

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BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

College Notes

(Continued from Page 142)

There is opening for several electives both technical and non-technical during the five years.

The University of Minnesota has a new Electrical Engineering Laboratory in which special attention is being paid to illumination engineering. This rather new phase of E. E. is taken care of in four laboratories designed exclusively for the purpose. Minnesota is one of the first universities to recognize to such a full extent the importance of illumination and its technical problems.

Illinois is not alone in the construction of new buildings. Michigan is completing a new Physics Laboratory which is elaborate in its detail. Entire supervision was vested in Prof. J. E. Sheperd, head of the department of psychology. Special care has been taken to meet all the requirements conductive to the best work in the laboratories. The wiring system of the building is extremely detailed. There are six complete individual circuits throughout the entire structure. This involves thirty large switchboards and thousands of wires. The statement was made by some of the workmen that the structural steel used in the support of the building might just as well have been done away with, and the entire weight carried by the wiring. Special ducts have been left in the walls to carry any further wiring that might prove necessary in the course of time. Another feature of the building is the refrigeration pipes running to the laboratories so that zero temperatures may be obtained without the use of ice. Several sound proof rooms have been constructed on the upper floor for work in the theory of sound. The floors of these rooms are made of removable concrete slabs.

A PROFITABLE BUSINESS

Tall Handsome Bandit (holding up train): "Now, I'll take the money from the men and a kiss from every woman."

Short Partner: "Never mind about the kissin', get the dough."

Old Maid in the rear: "You mind your own business, the tall man's robbing this train."

—*Pitt Panther.*

James: "See that woman with the dirty face, daddy?"

Father: "Why, James, her face is not dirty, she's that way all over."

James: "Gee, Pa, you know everything."

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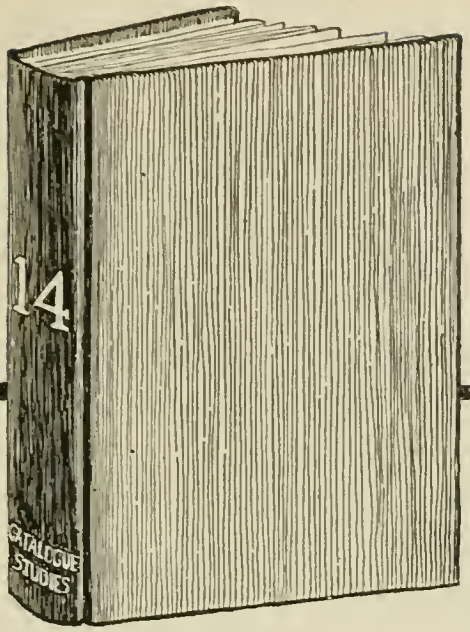
Ask your Librarian for Vol. 14 of Catalogue Studies to get complete information about the most economical and efficient use of explosives.



Vol. 14 of *Catalogue Studies* contains: "Eliminating Waste in Blasting", "Scientific Quarry Blasting", "The Scientific Selection of Explosives for Coal Mining", "Shot-firing by Electricity", "Land Clearing and Wood Utilization by Distillation", "Hercules Explosives and Blasting Supplies", "Flotation—A Brief Survey", "Hercules Galvanometers and Rheostats with Instructions for Their Use", "Dynamite—the New Aladdins Lamp", "Land Development."

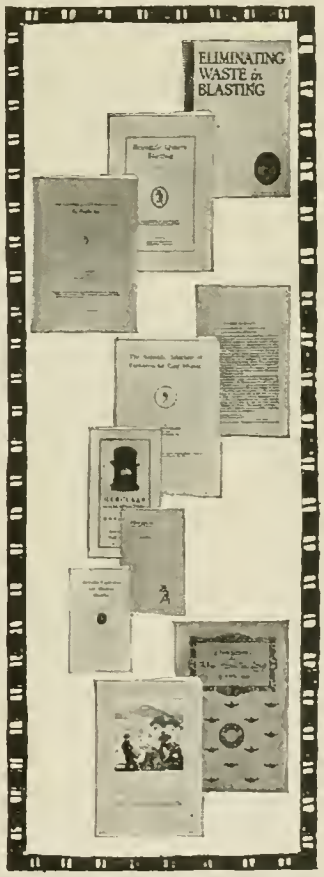
Catalogue Studies

KNOWLEDGE of the use of explosives is an essential part of the training of every engineer. This knowledge is at your disposal in Vol. 14 of *Catalogue Studies*—a series of books containing the technical literature of the leading manufacturers of the country. If you are not already familiar with it, ask your college librarian.

Vol. 14 contains ten authoritative text-books (as shown in the illustrations on this page), published by the Hercules Powder Co., which tell in detail, with illustrations and diagrams, how, when and where to use various explosives most economically and efficiently and explain the development of dynamite from its origin to the present day.

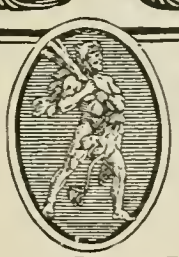
The booklet on *Flotation* is especially interesting to mining engineering students who wish to know about the concentration of ore by the use of flotation oils.

In the booklet entitled *Hercules Explosives and Blasting Supplies* you will find a complete list of Hercules publications to date, any of which will be sent you on request. Furthermore, if there is any special subject connected with blasting which is not fully covered in these books, The Hercules Powder Company Library will gladly furnish you with a bibliography on receipt of your letter addressed to 941 King Street, Wilmington, Delaware.



HERCULES

POWDER COMPANY



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AMERICAN SHEET AND TIN PLATE COMPANY, Frick Bldg., Pittsburgh, Pa.

Manufacture of Chemical and Scientific Porcelain

(Continued from Page 132)

for a plaster of paris mold. A small wad of clay is thrown into the mold and the jigger revolved at about 600 revolutions per minute. There is then lowered into the mold a cutting tool which shapes the clay on the inside of the mold. The mold with the wet ware is then placed in a dryer. After drying the newly made piece is finished with a sponge and sent to the upper compartment of an English type, two story, up and down-draft kiln where it is burned to a temperature of 1,100 degrees, Centigrade.

Only the simple shapes such as crucibles and evaporating dishes are made on the jigger. The more intricate or non-symetrical shapes such as combustion boats, mortars and pestles, Buchner funnels and centrifuges are made by casting. After the slip is screened it is pumped to the third floor to large tanks where it is stored until needed. The slip is poured into plaster of paris molds, the negative of the shape desired, and allowed to stand for several minutes. As the plaster absorbs the water from some of the slip, a thick layer of clay is formed on the inside of the mold. When this layer is of the desired thickness the remaining slip is poured off and the mold is allowed to stand until the ware is dry enough and has sufficient strength to be taken out. After finishing, the ware is sent to the kiln for the biscuit burn.

It might be stated that one of the chief difficulties in the manufacture of this ware is the loss due to breakage. All of this porcelain is quite thin and in the unburned state is very fragile, so any undue pressure of the slightest degree will cause breakage. If the piece does not break, it may be strained which will cause warping of the piece during the glost or high temperature fire. Near the end of the high fire period the ware has begun to soften considerably, so any portion of the piece which has been strained is liable to crack or warp badly.

After burning in the biscuit kilns, the ware is in a soft, porous condition. This condition, however, is desirable for glazing, as the ware when dipped will more readily hold the glaze on its surface. The glaze, which consists of kaolin, broken biscuit ware, feldspar, marble dust and whiting, is ground to 40 mesh size. It is then passed over a series of magnets to remove any iron which would give an objectionable color to the finished glaze. This is frequently a long process as the iron is very hard to remove and often the glaze must be passed over the magnets twenty-five times before it is clean. Every piece must be separately dipped, as no mechanical

(Continued on Page 158)

Engineering Organization at Illinois

We were sponsored by the engineering societies—remember that. No matter how we may expand, it shall always remain as a fact that the engineers gave to Illinois her co-operative book store. Make this store a monument to the industry and aggressiveness of the "College north of Green Street." SUPPORT IT.

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URBANA, 7-2201, 7-1903

This is the new small shape cap we are showing. It's a

"Knock-Out"

Gelvin Clothes Shop

Green Street

(Continued from Page 156)

device for dipping has proved practical.

After the biscuited ware is dipped, it is sent back to the lower part of the kiln. Here it is burned to the very high heat of 1,450 degrees, Centigrade, or 2640 degrees, Fahrenheit. When it comes from this fire it is completely vitrified, having no porosity or absorption. As the glaze is acid and heat resisting, it will stand very rigorous conditions and sudden temperature changes. It is not affected in the least by strong acids and only slightly by strong alkalies, as the high silica content renders it slightly acid in nature. This porcelain has the high translucency which is characteristic of all good porcelain.

This company makes a remarkable variety of ware ranging from the smallest combustion boats, about an inch long, to the large size 13 evaporating dishes with a 16.5 liter capacity. These large evaporating dishes represent the peak of ceramic technique for they are extremely difficult to make without defects, due to the thinness of the dish and the large area of unsupported surface. The slightest defect in workmanship will cause them to crack or break. This ware has now been perfected to such an extent that it can meet the foreign competition on an equal basis.

This plant is an outstanding refutation of the old idea that American clays and pottery are inferior to the foreign product. Industries such as these are purely American in nature and should be supported and protected as such. The Coors Company is very progressive and is always willing to try out any new idea which seems to have merit. This plant is only one of the many which are making ceramic products better than ever made before and, in addition, are making products which biased people said could never be made in this country.

LOGIC

"Say, Bill, I've got an idea on how to make pants last."

"How?"

"Make the coat first."

Mrs. Cohen (in swimming and standing in water up to her neck): "My goodness, Izzy, where's the baby?"

Mr. Cohen: "He's perfectly all right, I got him by the hand."—*Orange Owl.*

"There's nothing like combining business with pleasure," said the tailor's daughter as she lovingly wrecked the crease in her lover's trousers.

—*Froth.*

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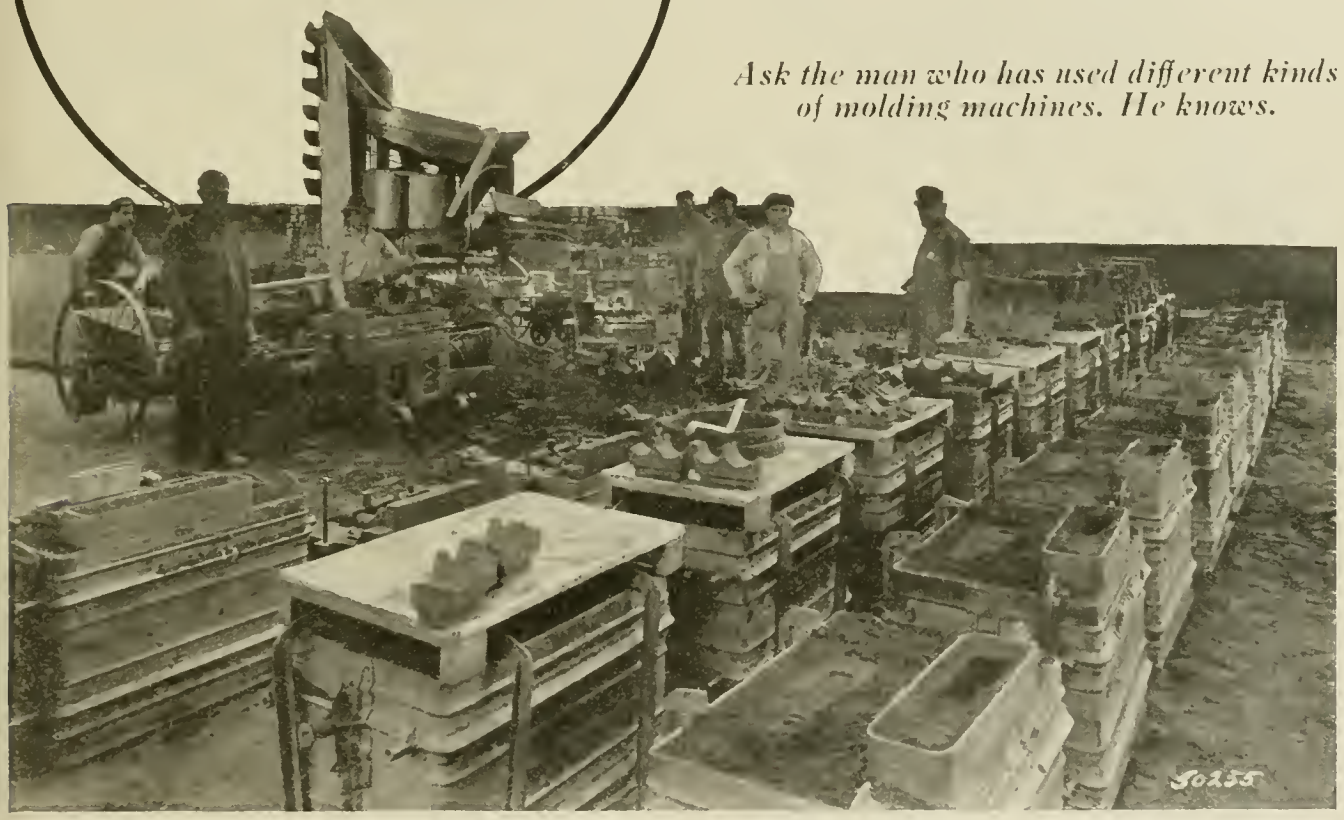

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such as the construction of large dams, irrigation projects, and other engineering works, Allis-Chalmers Crushing and Cement Making Machinery has demonstrated its reliability and economy in practically all of the projects of any magnitude in the United States as well as in many foreign lands where this equipment has also been extensiely used.

The Colon Crushing Plant of the Panama Canal, the Naval Dry Docks at Toulon, France, the Ebro Dam in Spain, the Great irrigation projects in Brazil, the Roosevelt Dam, Arrow Rock Dam, Black Warrior River Development of the U. S. Government, are some of the outstanding projects using Allis-Chalmers equipment. The Southern California Edison Company has employed Allis-Chalmers machinery in building the dams for five of its great hydro-electric developments.

These repeat orders over a period of years are evidence of the satisfactory operation of this equipment and of the service given by the Allis-Chalmers organization, whose varied lines of Power, Electrical and Industrial Machinery include nearly the whole field of engineering practice.

Let Allis-Chalmers Engineers Serve You

ALLIS-CHALMERS
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New University Buildings

(Continued from Page 118)

pass north of the new Agricultural Building. It will extend from its intersection with the old extension of Wright Street, east to the forestry. Wright Street will end at Armory Avenue instead of extending on into the campus as it does at present. Entrance to the new east and west road, and the old north and south road will be effected by a new road which will run diagonally southeast from the south end of Sixth Street to the intersection of the new and old roads just mentioned.

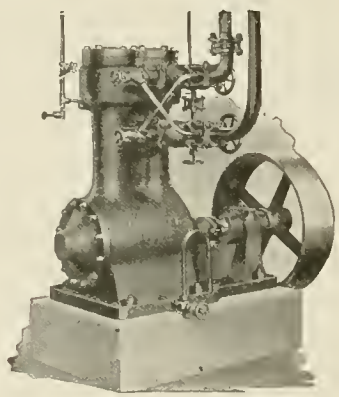
Undoubtedly the architectural treatment given to the new buildings, along with the changes in the campus will add much to the beauty of our University. The people of the state may well be proud of the University, and feel amply repaid for their investment of public funds in these well chosen and permanent units which are essential in the education of our men and women.

New Ceramics Department at M. I. T.

The announcement that a department of ceramics will be established at the Massachusetts Institute of Technology, Cambridge, was made at the annual meeting of the American Ceramic Society held February 4 to 7 at Atlantic City, New Jersey.

This will make the eighth school to offer courses in ceramics and ceramic engineering. The oldest is at Ohio State University but there are now departments at the University of Washington, Iowa State College, Rutgers College, New Jersey, Alfred University, New York, and Georgia School of Technology, as well as here at Illinois. The Ohio and Illinois schools are the largest while the latter probably has the most complete equipment of any in the country.

The plans for the new department are due to the work of S. W. Stratton, M.E., '84, the new head of the Massachusetts school.



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GOOD LIGHTING OF INDUSTRIAL PLANTS SECURES SAFETY AND EFFICIENCY.

The Code of Lighting for factories, mills and other work places of the State of New Jersey makes excellent recommendations of daylight for the proper lighting of industrial buildings.

Adequate daylight facilities through large window areas, together with light, cheerful surroundings, are highly desirable and necessary features in every work place, and they should be supplied through the necessary channels, not only from the humane standpoint, but also from the viewpoint of maximum plant efficiency.

Importance of Daylight.

The unusual attention to gas and electric lighting in factories, mills and other work places during the past few years; the perfection of various lamps and auxiliaries, by means of which an improved quality and quantity of lighting effects are obtained; and the care which has been devoted to increasing the efficiency in various industrial apparatus—all go to emphasize the many advantages and economies that result from vital and adequate window space, as a means for daylight in the proper quantities, and in the right direction during those portions of the day when it is available.

Three Considerations.

Three important considerations of any lighting method are sufficiency, continuity and diffusion, with respect to the daylight illumination of interiors. Sufficiency demands adequate window area; continuity requires (a) large enough window area for use on reasonably dark days, (b) means for reducing the illumination when excessive, due to direct sunshine, and supplementing lighting equipment for use on particularly dark days, and especially towards the close of winter days, (c) diffusion demands interior decorations that are as light in color as practicable for ceilings and upper portions of walls, and of a dull or matt finish, in order that the light which enters the windows or that which is produced by lamps may not be absorbed and lost on the first object that it strikes; but that it may be returned by reflection and thus be used over and over again.

Diffusion also requires that the various sources of light, whether windows, skylights or lamps, be well distributed about the space to be lighted. Light colored surroundings as here suggested result in marked economy, but their main object is perhaps not so much economy as to obtain results that will be satisfactory to the human eye.

Requirements for natural lighting:

1. The light should be adequate for each employe.
2. The windows should be so spaced and located that daylight is fairly uniform over the working area.
3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.
4. The windows should provide a quality of daylight which will avoid a glare, due to the sun's rays, and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.

As will be noticed in the above recommendations, large windows and proper diffusion of daylight are urged, in order to meet the demands of daylight lighting.

Shades may be eliminated and most efficient lighting obtained by the use of Factrolite Glass.

If interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

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Good Friends from now on

THERE'S good news at the plant. The production engineer and the chief inspector have buried the hatchet—their feud is ended—and all because of Ground-Form Cutters.

For months Jones, the engineer, thought that big Mac, the chief inspector, was rejecting gears in order to give production a black eye.

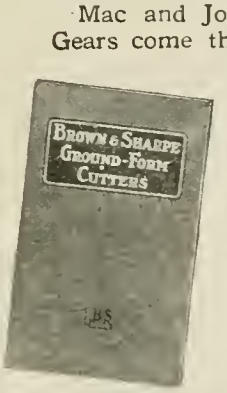
"They're good gears, Mac," protested Jones. "What's the matter with them?"

"Sure they're good, if you take them one by one," replied Mac, "but in big lots they're not uniform enough to pass inspection."

And so the war began; Mac grew more careful, and Jones felt sure that Mac had a personal grudge against him.

Then Jones discovered Brown & Sharpe Ground-Form Gear Cutters. He heard that they would increase production and at the same time improve the quality of his gears. He tried a few. Now, all his gear cutting machines are equipped with Ground-Form Gear Cutters.

Mac and Jones are good friends now. Gears come through faster than ever and rejections are few and far between.



Here is the booklet that proved so valuable to Jones. You can avoid his difficulties by getting acquainted with Ground-Form Cutters before the full responsibility of production falls on your shoulders. Write today for your copy of this instructive booklet.

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Mr. Keating will be glad to advise you as to style and kind best adapted to your particular needs;—drop in during that off hour.

Just to give you an idea of how comprehensive our stock is:

Make	Sizes in Inches	Styles
Keuffel & Esser	5, 8, 10, 16, 20,	Polyphase Poly Duplex
Dietzen	8, 10	Dietzen

Also magnifying glasses, sewed leather cases, Manheim rules, and special rules

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Air infiltration losses in a boiler setting is one of the big and preventable losses in boiler room operation.

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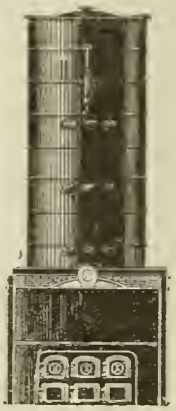

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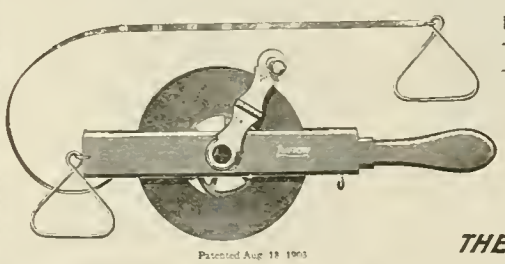

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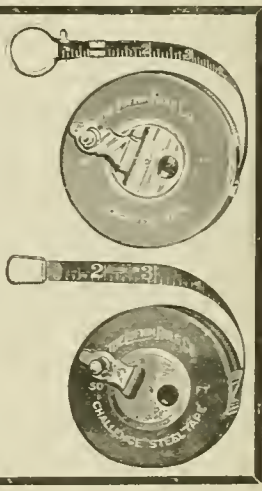


THE LUFKIN RULE CO. SAGINAW, MICH. New York, London, Eng., Windsor, Can.

CUT OF THE ENGINEERING FRATERNITY INSIGNIA

Through the co-operation of the various honorary and professional engineering fraternities, it is possible for the Technograph to give to its readers, in this issue, a cut showing the actual size of the keys and pins of the various engineering fraternities. There are thirteen honorary and professional fraternities that are active at the University of Illinois. Seven of these are departmental honor organizations, many of which were founded here.

The Technograph is pleased, at being able to present this cut, and appreciates the co-operation of the fraternities who aided in getting it out.

LEACH VS. SAMPSON

The instructor in T. & A. M. 25 was discussing columns—with special reference to Euler's formula—when J. C. Leach, '25, roused himself from deep thought to deliver himself of the revolutionary opinion that the famous Sampson may have been very much overrated. For was it not possible—Mr. Leach preceded to expound—that the temple columns, being exceedingly tall and having been loaded by those benighted pre-Eulerian engineers to the critical load, may have required but a gentle caress from the blind Sampson to introduce the slight additional deflection that set the whole works toppling.

Thus do our studies of the sciences make for agnosticism. Mr. Bryan please note.

Freshman advisor: "Always love your teachers."

Rook: "I tried that once but she got mad."

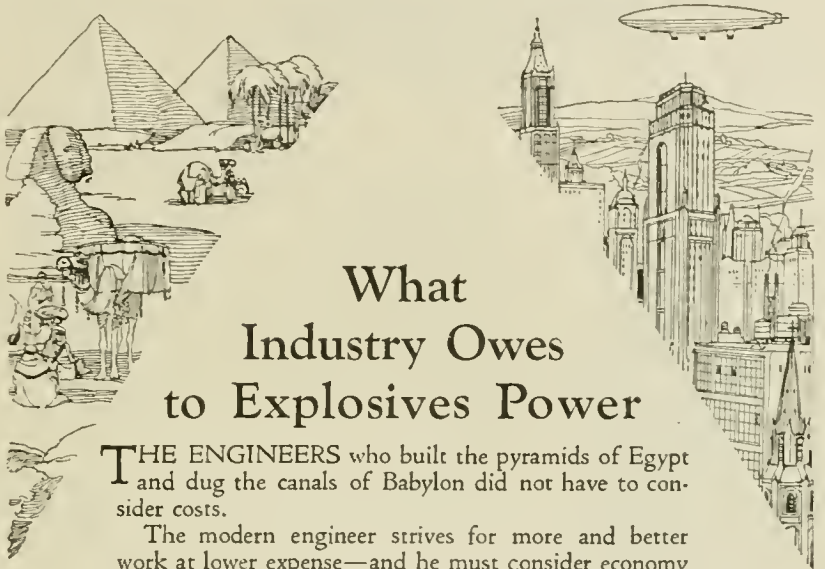
Visitor: "Say sonny, how can I get to Lincoln Hall from here?"

Frosh: "Do you have a car?"

Visitor: "No, I don't."

Frosh: "Well, I guess you'll have to walk."

G.R.GRUBB & CO.
ENGRAVERS
CHAMPAIGN,
ILLINOIS.



What Industry Owes to Explosives Power

THE ENGINEERS who built the pyramids of Egypt and dug the canals of Babylon did not have to consider costs.

The modern engineer strives for more and better work at lower expense—and he must consider economy as well as accomplishment.

The economical production and distribution of wealth are made possible today through the use of explosives. And the enormous consumption of explosives throughout the world is an index of the influence they exert in our economic life.

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Applied Science and the Engineer

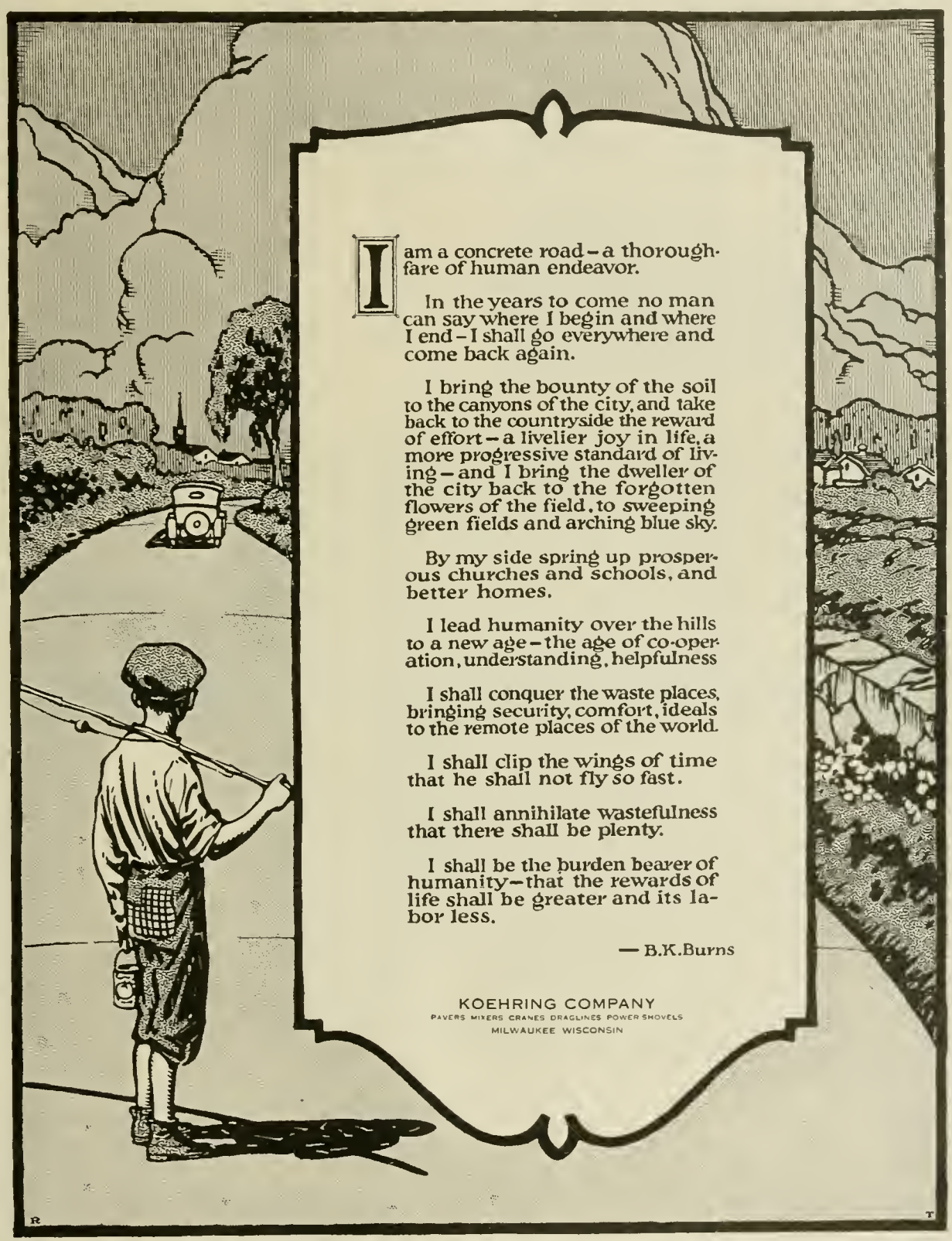
(Continued from Page 123)

to inform the public properly on many economic and technical phases of our industries. But before the engineer can gain the proper respect of the public he must acquire a broader conception of the uses of the tools of his art.

This increasing spirit of discontent among engineers of the considerations which now dominate the business world and places serious handicaps on the engineer in reaching the position in the business world to which his ability and importance rightly entitle him, is rapidly changing the status of engineers everywhere. I recently made a study of the careers of a large number of engineering graduates. Each year out of the university showed a change in an increasing percentage from engineering work to other work. Not one change was found due to failure, but was mostly entirely due to logical changes in occupation and promotion to positions of leadership and responsibility. In practically all cases where the higher positions had been obtained, a study of economics, finance and business organization had been obtained by other university work or home study.

The history of the engineering profession shows a great growth of engineers but a proportionally greater growth of other professional classifications having to do with the application of technical facts or processes. Modern civilization depends upon technical processes, and economic salvation lies in greater production per man by the aid of machinery. Progress and larger development in the purely technical features of industry are possible and highly desirable, but the conception of new ideas, processes and radical departures from established practices are relatively less important than the commercial development, proper management and the securing of the necessary capital in ever increasing amounts from a larger number of persons. The mastery of the technical features, while they may come first, are more easily reduced and controlled with a corresponding decreased technical ability necessary. The commercial developments, managements and financing features of a business are assuming greater importance each year, and if the vast amount of technical information now available be applied to the best economic advantage, the engineer must show the way.

I do not believe the engineer is designed to be a scientist or even a near scientist, but essentially a business manager versed in all the technical features of business. The progress of the engineering profession must come from within and from the roots up and not from the branches down as a great many speakers recently have seemed to think.



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I bring the bounty of the soil to the canyons of the city, and take back to the countryside the reward of effort – a livelier joy in life, a more progressive standard of living – and I bring the dweller of the city back to the forgotten flowers of the field, to sweeping green fields and arching blue sky.

By my side spring up prosperous churches and schools, and better homes.

I lead humanity over the hills to a new age – the age of co-operation, understanding, helpfulness

I shall conquer the waste places, bringing security, comfort, ideals to the remote places of the world.

I shall clip the wings of time that he shall not fly so fast.

I shall annihilate wastefulness that there shall be plenty.

I shall be the burden bearer of humanity – that the rewards of life shall be greater and its labor less.

— B.K.Burns

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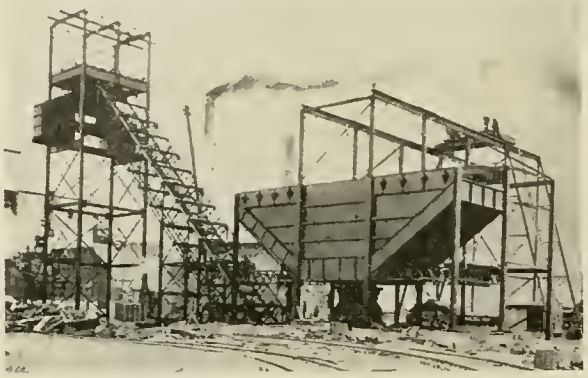

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The Value of Cultural Studies to the Engineer

(Continued from Page 137)

enjoyment of life. The color and vigor of happiness belongs only to the broadly educated engineer. The one-rut technical specialist is a soulless plodder,—an automaton with a single duty in a lifeless machine.

The Bible holds no greater truths than in Matt. XVI: "For what is a man profiited, if he shall gain the whole world and lose his own soul?"

Freshman adviser: "Always love your teachers."

Rook: "I tried that once but she got mad."

Visitor: "Say sonny, how can I get to Lincoln Hall from here?"

Frosh: "Do you have a car?"

Visitor: "No, I don't."

Frosh: "Well, I guess you'll have to walk."

DARKTOWN STUFF

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PUBLISHED QUARTERLY BY THE STUDENTS OF THE
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May

1924

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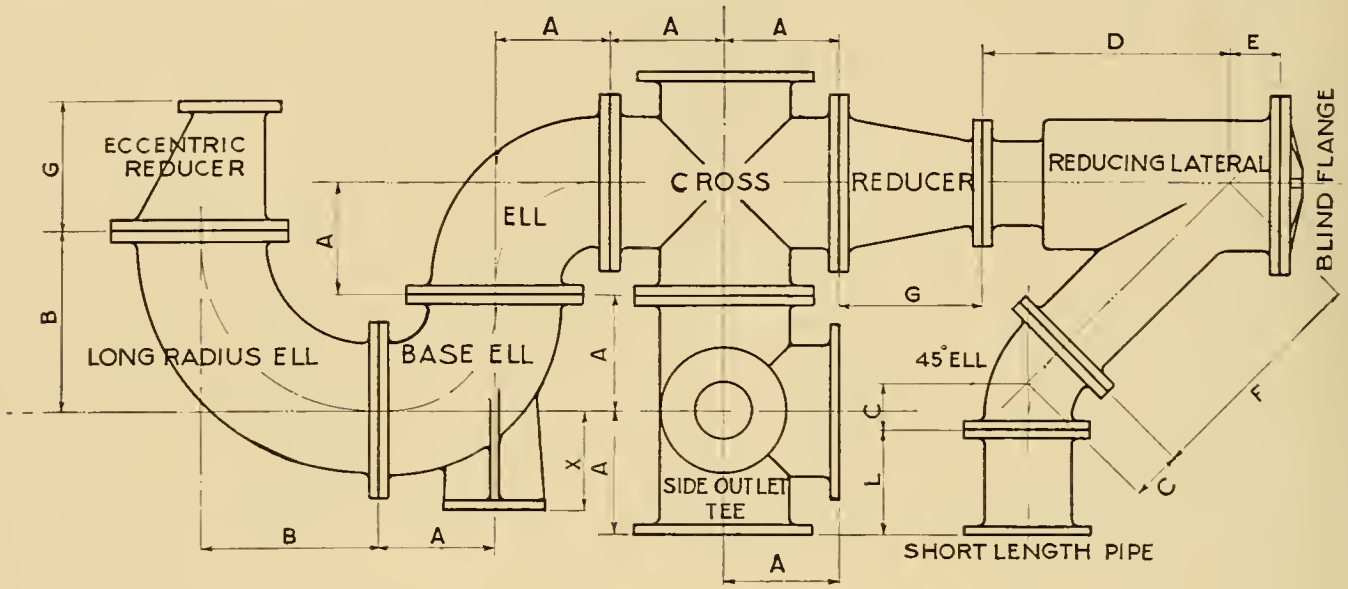

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Dr. Nathan Clifford Ricker

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VOL. XXXVI MAY, 1924 NUMBER IV

Dr. Nathan Clifford Ricker

July 24, 1843 — March 19, 1924

L. R. Ludwig, ry.e.e., '25

When one who has been great among us is called away, we pause to pay humble tribute to him whose life has been an inspiration to us throughout his years. The University of Illinois and its Department of Architecture have suffered a very real loss in the death of Dr. Nathan Clifford Ricker. For 56 years Dr. Ricker has given the greater part of his life to the building up of the Department of Architecture to its present high status. Faithful and untiring energy, broadness of mind, and love for his fellow men have been the ever dominating characteristics of his life. As a teacher, and more, as a friend to his students, Dr. Ricker was loved and respected by all who knew him.

Mr. Ricker was born in Acton, Maine, July 24, 1843. His boyhood was spent in the rugged New England hills. When thirteen he took up millwork, and followed it for thirteen years, the while paving the way for a University education. When eighteen he did the first work in his chosen profession. After teaching school for two years Mr. Ricker left home, feeling more strongly the need of a better education. He worked at piano casing for two years, entered the University of Illinois in 1876. His university education was entirely obtained through his own efforts, and the period of preparation required long hours of evening study previous to his entrance. He worked as a carpenter while attending school, and in 1870 built a spring wagon for the Horticulture Department in conjunction with Mr. Cantrell. The wagon did ten years of hard service. In 1872 Mr. Ricker spent six months in Chicago with the architectural firm of J. W. Roberts. He then returned to the University and was graduated, completing the entire course in slightly over three years. During the last term he served as temporary head of the department.

After graduating Mr. Ricker went abroad and spent six months studying in Europe, particularly at the Bau Academy in Berlin. He then returned as full time instructor at the University. During this period he translated many French and German works for use in his classes. By degrees he collected the volumes which now make up the library which bears his name, the Ricker Library of Architecture. For 17 years he was unaided in the department.

Dr. Ricker has been Head of the Department of Architecture, Dean of the College of Engineering, and a member of the State Board of Examiners. During his busy life he has found time to write the text "Trussed Roofs" in addition to his translations. While at the University he has designed and built the Law Building, the Gymnasium Annex (old Armory), the Natural History Building and the Library. He introduced the Russian system of Shop Practice in this country after returning from Europe.

The true energy of Dr. Ricker's nature has been well revealed by his own phrase, "Better wear out than rust out." During the period in which he so capably filled the positions in the Department of Architecture, two degrees were conferred upon him by the University. In 1878 he received the degree of Master of Architecture, and in 1900, Doctor of Architecture. He was active in the department until 1917 and has since been in close touch with it as Professor Emeritus. He continued his great work up to within a few weeks of his death which occurred on March 19, 1924.

Anaconda Reduction Works

C. H. Dodge, min.e., '24

The first warning that the observer is given of his nearness to the great Washoe Smelter and Reduction Works, as he approaches by auto road from the copper mining city of Butte westward toward the town of Anaconda, Montana, is the sight of a chimney rearing itself above the skyline of the foothills and bluffs of the rocky mountains. On rounding the next hill the panoramic of the entire plant stretches itself out in view rolling down the entire length of a foothill as shown in the accompanying view.

At the peak is this chimney, first seen as dwarfed by the big bare mountains enclosing it, but now revealing its great size by comparison with innumerable average sized stacks that rise above the shops. This chimney, like the plant it towers over, is the largest in the world, its brickwork rising six hundred and eighty-five feet above the hill top on which it stands, tapering from seventy-five feet at its base to sixty feet at the top. (Inside diameters given.)

The Anaconda Reduction Works is the second of three steps in the mining, milling and smelting, and the refining of copper ore. The vast deposit of copper ore at Butte is mined principally from the shafts of the Anaconda Copper Mining Company. It is transported over the Butte, Anaconda and Pacific railroad, an electrified road owned by the same company, to the mills and smelters at Anaconda where the ore is crushed, concentrated by milling, and smelted and refined into copper plates. These plates are then freighted to Great Falls, Montana, or to the company's New Jersey plants, where they are refined by electrolytic process and the gold and silver content recovered.

The first copper mined, 1882-1884, was shipped to Swansea, Wales, because of the lack of mills and smelters in this country. From 1884-1892, only the copper concentrate, averaging 64 per cent copper was shipped, as at that time mills had been erected at Butte to concentrate the ore. With the increase in demand for copper, especially from the electrical world, came the need for local refining of the red metal. In 1894, the Washoe Smelter was built and from a production of five hundred tons of the metal from very high grade ore the mills have enlarged until the present reduction works has a daily capacity of seventeen thousand tons of ore, treating ore as low as 3 per cent copper successfully. The normal output is 16 per cent of the copper produced in the United States and 9 per cent of the world's production. It has shipped eight billions of pounds of copper in the past forty years.

The ore is received at the Works in fifty-ton gondolas and is unloaded into large storage bins situated on the top terrace of the plant. From these bins the ore is run through massive jaw and gyratory crushers where the ore is reduced from 15 inch lumps or smaller to 2 inch size. This finer size is then treated by Harz (water) jigs which mechanically separate, with the aid of rising currents of water, the heavier richer ore from the lighter low grade ore.

The heavy ore, rich in copper, is sent direct to stock bins and then on to the blast furnaces for smelting. A unique and economical feature of smelting this high grade ore is the ability it has to support and maintain combustion in the blast furnace without external aid once the ignition temperature has been reached. This is because of the high sulphur content in this chalcocite ore. The blast furnace product rejoins the concentrated low grade ore at the reverbatory furnaces.

The blast furnaces each have a capacity of twenty-five hundred tons of charge per twenty-four hours. The treatment here increases the copper content from 8 1-2 per cent to 40-50. Sixty per cent of the total sulphur is burned off and a part of the remaining charge is eliminated with the limestone flux.

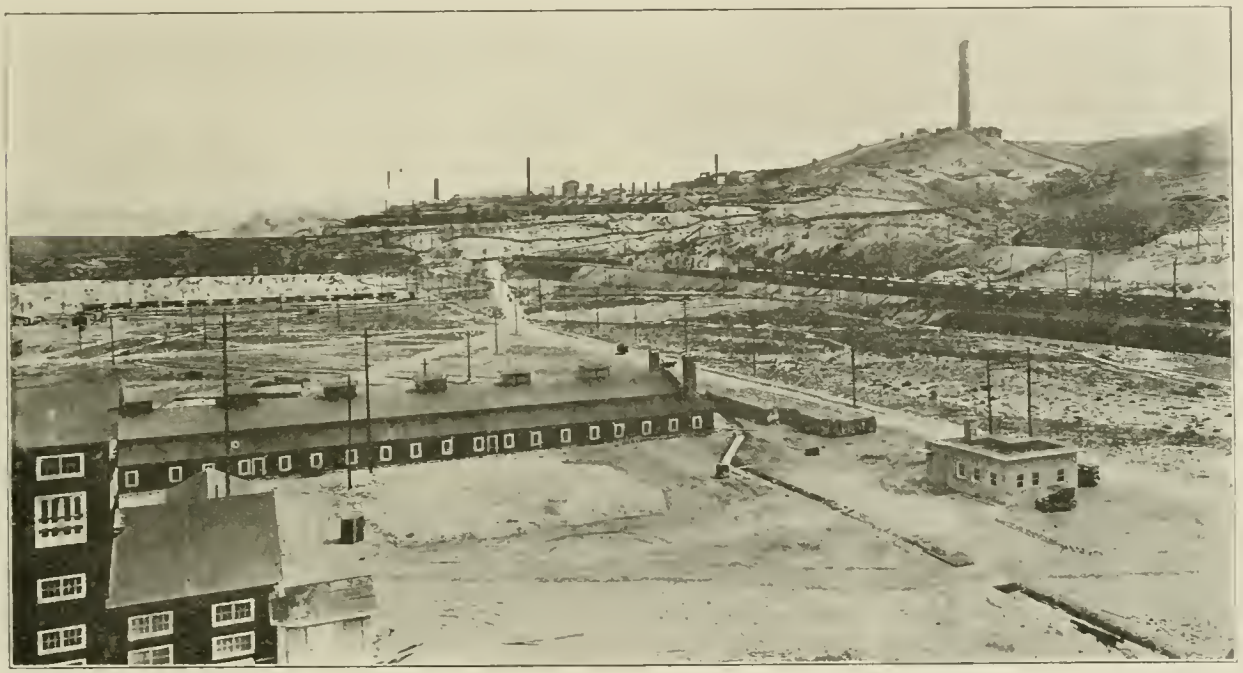
The lower grade ore which leaves the jigs as middlings, part concentrate and part rock, is recrushed by rolls and sized through revolving trommel screens, the undersize passing to Evans jigs and the oversize returned to the rolls. Much of the waste rock, monzonite in most part and practically free of copper is washed over the ends of the Harz jigs and rejected.

The concentrate from these jigs goes direct to the roasting furnaces, the middlings to the rolls and then to desliming cones. The residue from the cones is sent to concentrating tables and the overflow from the cones direct to the flotation department. The wet concentrates are dried on Oliver vacuum filters and Lowden driers before going to the roasting furnaces.

The Wilfey concentrating tables again separate out a concentrate which is sent to the roasting furnaces. The table middlings are sent to Hardinge conical ball mills for sliming. The waste product or tails joins that from the Evans and Harz jigs and

is carried to dumps. The Hardinge ball mills grind the table middlings to a very fine size, sliming its feed in fact, and thus delivers the ore in proper condition for flotation.

The flotation machines complete the mechanical separation of the mineral from the rock or gangue; and this is the only step which uses chemical aid. The slimes are received at these cells, agitated by paddles, currents of air being forced up through the liquid mixture of water and a small amount of light oil. The heavier metallic particles of the mineral are caught up by the rising air bubbles, carried



View of Washoe Smelter and Works, Anaconda, Montana

to the top of the cell and overflowed, the sands remaining at the bottom because of their lack of affinity for these same bubbles and are drawn off at the bottom of the cells.

Ninety-five per cent of the copper is saved by these relatively cheap processes, while nearly two-thirds of the ore, as gangue, is discarded. Previous to the introduction of flotation the recovery was very low as earlier practice did not permit of fine grinding and the release of much of the copper-bearing mineral which had previously been lost as waste.

The old waste dumps had become veritable mountains. They are now being retreated by roasting the sulphides to oxides and dissolving the copper-bearing sands in sulphuric acid and then precipitating the copper by leaching in large tanks with iron.

There are 64 roasting furnaces to handle the jig and table concentrates, each containing 6 hearths, 15 feet in diameter, and each furnace having a capacity of 45 tons per 24 hours. The concentrates are fed automatically to the top hearth and moved from the circumference to the center by rabbler arms. Here the concentrate drops through to the next hearth across which it is similarly moved to the circumference. This stirring action constantly exposes fresh surfaces of the charge to the hot gases rising from the lower hearths. From the second hearth down the heat is great enough to roast the ore.

The remaining concentrates are handled by a battery of 28 furnaces, of 7 hearths each, 23 feet in diameter, and having a capacity of 125 tons per 24 hours per furnace. The sulphur content is decreased from 30 to 9 per cent by this roasting.

The reverbatory furnaces, which comprise the third step in the reduction process, receive most of their charge as calcine from the roasting furnaces, the rest being flue dust. The purpose of these reverbatories is to remove as much sulphur as possible, iron and other impurities from the concentrate by slagging impurities with lime and silica and also driving them off as gases. The refined copper is drawn off as a matte and is then ready for the final step of reduction in the converters.

Much heat is conserved by transferring the roasting furnace product in red-hot condition to the reverbatories by gravity feed from hoppers through iron piping. The heat in these latter furnaces is easily controlled as they are fired by blowing pulverized coal in at one end, the combustion being

similar to that of a gas. This also means a large saving in fuel. To show the remarkable efficiency which has been attained it might be stated that the smelting capacity of one of these furnaces has been increased from 20 tons of charge per 24 hours, using 10-12 tons of coal in 1884, to 530 tons of charge per 24 hours, using 80 tons of coal in 1920, amounting to 26 times the capacity on 16 times the hearth area with only 8 times the tonnage of coal.

Of all the operations in the Reduction Works, as is also true of the Bessemer process in steel making, the converter process is the most spectacular.

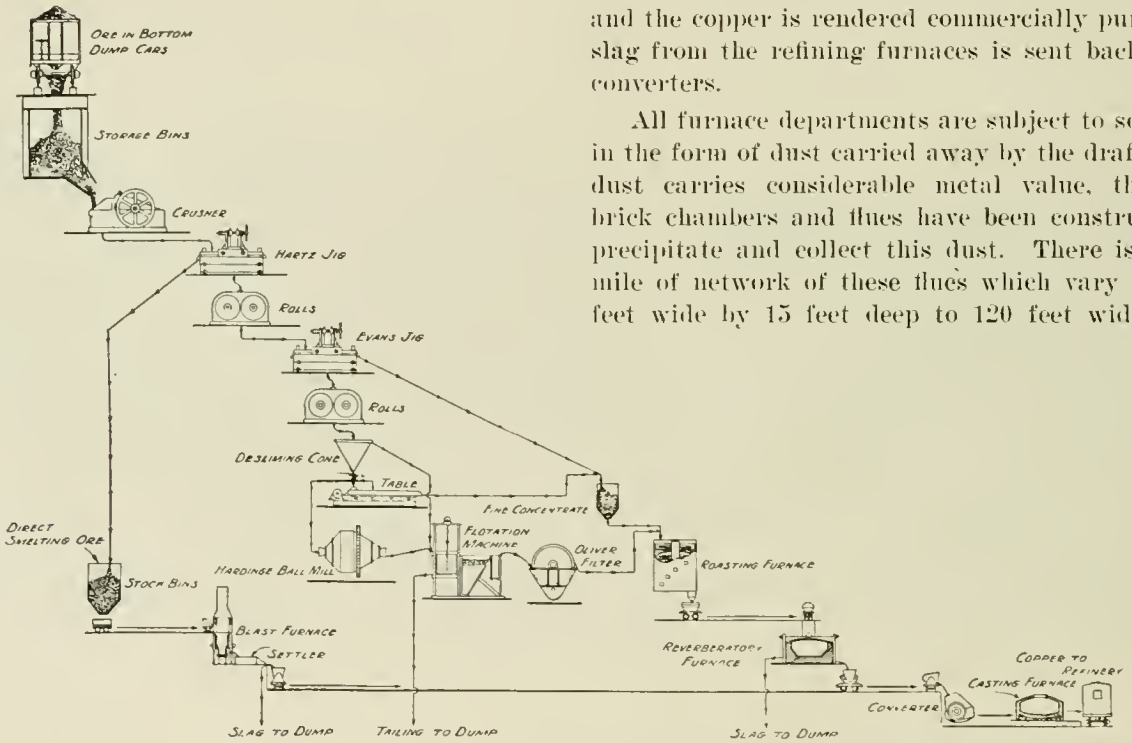


Diagram Showing Steps in the Reduction of Copper Ore

The flames, sparks, smoke, and play of colors is unrivaled by any of the many metallurgical displays. This is the last important stage in the series of eliminations that finally leaves metallic copper. The matte, in molten form, is brought from the reverbatories and blast furnaces in ladles and poured into the converters, 65 tons to a charge. Air, at 16 pound pressure per square inch, is blown through the liquid mass and burns out the sulphur and iron.

The metallic copper, alloyed with silver and gold, settles to the bottom and is then poured into ladles to be transferred to the refining furnaces. The converter process requires five hours for slagging and finishing. Unlike the slag from other furnaces, the converter slag is too rich to be thrown away. Most of it, while still liquid, is taken to a special reverbatory furnace where it is combined with additional calcine, dried concentrate, and fluxes. The slag from this furnace is discarded and the refined copper returned to the converters.

The metallic copper delivered by the converter still contains small amounts of sulphur and iron as well as a little slag. Refining furnaces have been added in which, by more careful treatment can be possible in the converter, the impurities can be burned out or slagged and thus eliminated.

The refined copper is tapped and run into water-cooled molds which deliver the copper in the form of plates, electrodes, and are loaded directly into freight cars for shipment to the company's electrolytic plants where the silver and gold are removed and the copper is rendered commercially pure. The slag from the refining furnaces is sent back to the converters.

All furnace departments are subject to some loss in the form of dust carried away by the draft. This dust carries considerable metal value, therefore, brick chambers and flues have been constructed to precipitate and collect this dust. There is over a mile of network of these flues which vary from 20 feet wide by 15 feet deep to 120 feet wide by 40 feet deep. The dust settles into hopper shaped bottoms and is drawn off into cars that return it to the reverbatory furnaces. All flues finally discharge into a main flue which terminates at the base of the giant chimney previously described. To further emphasize the size of this chimney it might be noted that it discharges three to four million cubic feet of gas per minute. Some of the gases rise more than 1000 feet in their passage through the flue system before leaving the top of the stack, with a total travel of more than seven-eights of a mile.

A considerable amount of arsenic is carried with the dust (being a part of the original ore) which formerly was discharged into the atmosphere and, on settling, destroyed vegetation over an appallingly large area. The effects are still to be seen. These

(Continued on Page 216)

Fuelizers

R. B. Sargent, m.e., '24

Within recent years perhaps no single branch of automatic engineering has received more attention than the vaporization of the fuel used. Radical engine cycles, counter-balanced crank shafts, valves and all sorts of mechanical improvements have attracted the attention of automotive engineers, particularly in the case of the high speed automobile engines, but the one problem of thoroughly vaporizing the gasoline is common to all branches of the industry. As engine fuel has gradually become less volatile, truck, tractor and automobile engineers have spent more time on this problem of delivering to the cylinder a perfectly "dry" gas.

Most of the gasoline used today contains a large per-cent of kerosene which will not vaporize readily in the atmosphere without the application of heat. Unless some means of vaporizing this fuel is incorporated in the construction of the engine, at the point of firing there will be a "wet" fog of fuel in the engine cylinder. This fog wets the sides of the cylinder and the liquid runs down past the piston rings, causing crank case dilution. It is a common occurrence, especially in the winter time, to drain more oil from the crank case than was put into it, even after running several hundred miles. This "extra oil" comes from the gas tank. It is injurious to bearings and cylinder walls, aside from being an absolutely apparent loss in efficiency.

A thin black smoke is often seen coming from many cars' exhaust pipes. This is caused by burning in the exhaust pipe of little globules of fuel which make up the fog and which do not strike the cylinder walls. These liquid drops of fuel burn only on the surface and in so doing burn slowly, so that much of the fuel is actually expelled through the exhaust pipe, where it does not give us the "punch" on the piston top, a further loss in efficiency. Such are the two most important disadvantages of using a "wet" gas.

In view of these disadvantages of poor vaporization a complete understanding of the ideal condition of the fuel should be had. By fuel is meant the combustible mixture of air and gasoline as it is compressed in the cylinder. First, it should be a perfectly "dry" gas, for reasons already stated. Second, it should be as cold a mixture as possible. The power of an automobile motor varies inversely as the absolute temperature of the gas in the cylinder at the beginning of the compression stroke, everything else being constant. This fact may be shown by going to the extremes. The greatest number of heat units or amount of power, could be taken into the engine cylinder were the mixture in a liquid state. Could this mixture be heated to several thousands degrees Fahrenheit without kindling, it would be so expanded that only a very few units would be taken in with each stroke. The fact may be stated mathematically as follows: Let P and p, and F and f, be the powers and temperatures degrees F. absolute respectively of two automobile engines. Then P : p :: f : F.

Obviously it is quite impractical to take in air much below zero degrees F. in this climate, and due to the temperature at which gasoline vaporizes the temperature must be even higher. The proper temperatures for the combustible mixture have been determined experimentally to be between 100 degrees F. and 15 degrees F. Once vaporized, even kerosene will not readily condense at this temperature. The ideal condition then, for the mixture at the start of compression is to be dry, and at a temperature between 100 and 150 degrees. This is the fuelizer problem now in the process of solution in the automotive industry. The problem would be an easy one were it not for the fact that these two conditions seem incompatible, with present day fuel. To prevent using a wet mixture, or to vaporize all the gasoline in common use, requires a temperature of nearly 500 degrees F. But, as stated, it is desirable that the temperatures be about 125 degrees F.

The ordinary "hot spot" manifold of today effects a compromise between these two opposing conditions. Most of the low boiling points are vaporized as they impinge upon some hot surface in this type of manifold, and the hot air is heated to a temperature of perhaps 200 to 300 degrees F. Intake manifolds used to be made with as few and gradual turns as possible, so that the mixture might not be retarded by pipe friction or inertia. Today many of them are cast integral with the exhaust manifold and contain several sharp corners, the theory being that the liquid fuel will hit the sides of the manifold at the corners and be vaporized by the heat of the exhaust. Such a construction attempts to vaporize the fuel without heating the air to a high temperature.

It should not be overlooked that the "poor vapor" condition exists at light loads more so than at medium and full loads. This is because carburization is better at high gas velocities and because the greater heat of compression at full loads aids in the vapori-

zation of the fuel during the compression stroke. For this reason devices are used to heat the mixture at light loads more than at full loads. Buick jackets the carburetor with exhaust gas which is passed to the carburetor only at light loads. As the throttle is opened a butterfly valve in the exhaust pipe also opens, allowing the exhaust gas to go straight through the exhaust pipe and not around the carburetor. Packard uses what might be termed a "pilot light," which burns and discharges its hot products of combustion to be mixed with

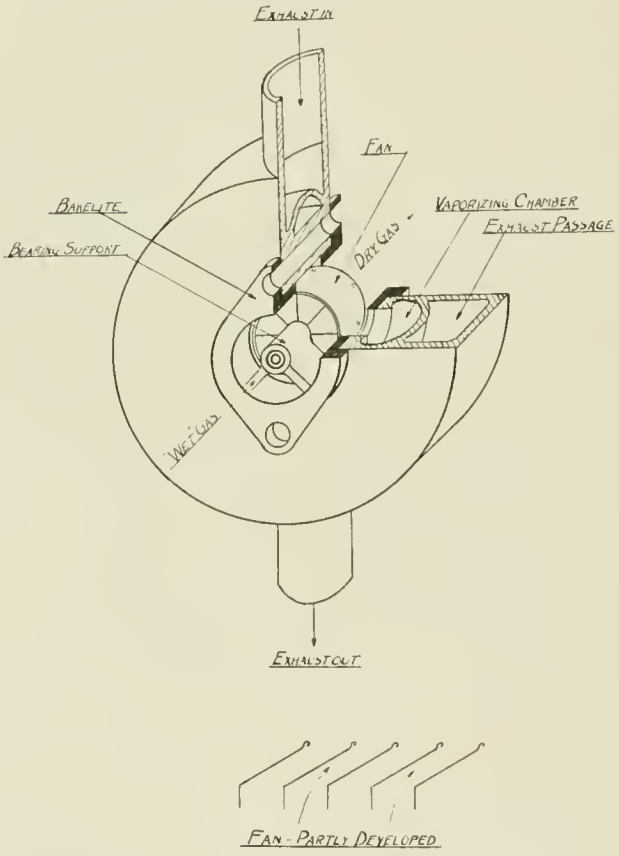


FIG 1.

SECTION THROUGH FUELIZER

the combustible mixture at light loads and starting only.

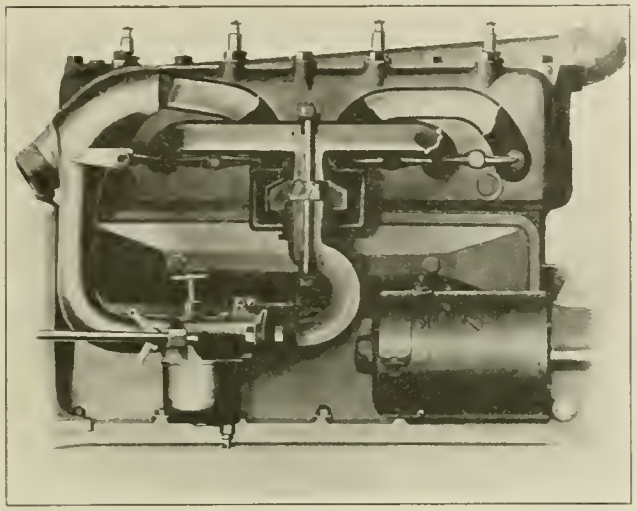
A fuelizer which would separate the fog from the mixture of gasoline and air, leaving the mixture cold, and delivering the liquid to a hot vaporizing chamber, from which it could return vaporized to the cold mixture stream would be ideal. It has been the author's privilege to experiment on such a device. Briefly, it consists of a fan rotated in the intake manifold by the incoming mixture about an axis parallel to the gas flow and having blades so shaped that liquid drops of fuel entering with the gas are extracted from it and thrown by centrifugal force into an annular chamber kept hot by the exhaust; in this chamber the liquid is vaporized and returns to the intake manifold. A general idea of its construction may be had from figure 1. The gas stream is insulated from any hot surface by the Bakelite shown. Each blade has two sections, one parallel to the flow of gas and one at an angle of 60 degrees to the flow. On the edge of each blade is a small "evespout." The blades are surrounded by a brass band to prevent their flying out of the hub by the centrifugal force, and also to cause less friction of the gases as they pass by the annular ring. In going through the fan, the direction of air must change about 60 degrees. As the weight per unit volume of gasoline is 600 times that of air it has 600 times the inertia of air. Small globules of gasoline carried along in the air stream tend to go straight ahead when passing through the fan. They impinge upon the bent blades and are blown along the surface until they reach the small evespout at the edge. Centrifugal force throws the liquid through small holes in the brass band co-incident with the evespouts into the annular chamber, where it is vaporized by the heat of the exhaust. The vapor returns to the air stream through the clearance cracks around the rim of the fan.

Several "bugs" or imperfections of design had to be overcome before the fan was a mechanical success. The first fans were not surrounded by a band and as the fan rotates at very high speed when the car travels above thirty miles an hour, considerable trouble was experienced with the blades flying out due to centrifugal force. Several of the first fans lost every blade. One blade was found in the intake manifold; where the others went is a mystery. They probably succeeded in being blown past the intake valve and were either burned up in the engine or expelled with the exhaust. The only indication that the device was not there was a loss in mileage. However, by putting a band around the blades, as shown, no further difficulties were experienced from this source. By using a long bearing of drill rod against ordinary steel the bearing wore about 2-1000 inches in 10,000 miles of car operation.

The fan is easily constructed. The blades are formed by stamping and are pressed into saw cuts in a brass hub which is pressed over the steel shaft. Around the outside of the blades is then pressed the brass band and the whole is dipped in solder to complete the job. It is not necessary that the fan run absolutely true so long as it is fairly well balanced. The moulded Bakelite insulation is used as a fan bearing support. The casting itself may be made of aluminum, brass, or bronze.

A few simple tests show the effectiveness of the fan in separating liquid fuel from the air stream. Compressed air containing so much water that it

would wet anything toward which it was blown was turned through the fan. No visible moisture passed the blades, while a disc of spray was thrown from the periphery of the fan, as water is thrown from a rotating emery wheel. Red Crown gasoline was used when another demonstration was made. After warming up an engine equipped with the device it was stopped and the exhaust connection removed. The engine was then run at light load for a few minutes. A draining of the vaporizer yielded a quarter of a pint of "gasoline" which would not burn when touched with a lighted match. Obviously the low boiling points had not vaporized all of the gasoline before striking the blades, and it had been separated from the air stream and deposited in the vaporizing chamber.



Fuelizer Attached to Ford Engine

The theory of this device seems flawless, and in practice it does much to increase the mileage and performance of a car. The first one built was placed on a Hudson Supersix. The car's average mileage increased from ten to fifteen miles a gallon. Experiments were made to determine whether or not a leaner mixture could be burned with the same performance as with the richer mixture. Little satisfactory data can be shown on such a subject because performance is more often, as it was in this case, measured by the sensations than by the stop watch. Suffice it to say that acceleration was a little more rapid than without the device, and the maximum speed increased from 63 to 68 miles per hour. In the case of speed the effect of the improved gas at the point of explosion was most marked. Poor and irregular firing due to a poor, slow burning mixture had made the limit 63 miles per hour. Missing at this speed was very noticeable, until the fuelizer was put on the car. Then no missing occurred at the higher maximum speed.

Perhaps the most noticeable improvement in performance was in cold weather warming up. An easy get-away in high with no spluttering in the cold winter months was an outstanding attraction of this device.

As originally applied, the exhaust jacket was merely connected to the exhaust pipe, only the back pressure caused by the muffler forcing exhaust through the casting. Later a butterfly valve controlled from the dash was put in the exhaust pipe, the exhaust being by-passed to the fuelizer. By forcing all the exhaust through the fuelizer it could be kept hot enough at medium and heavy loads to vaporize kerosene. Several trips were taken using kerosene as fuel, but the results were not satisfactory because of the tendency of the fuel to detonate at each slight increase of load. The best mileage made with kerosene was 22 miles to the gallon on a 60 mile trip. Fuel was carried on the dashboard in a graduated glass, and added a quart at a time. About the same average mileage was obtained with kerosene as with gasoline, the only difference between the two fuels being the kerosene's tendency to knock. At low speeds kerosene did not prove satisfactory because of the low temperature of the exhaust, being around 300 degrees at light loads.

The consistent increase in gasoline mileage made the device pay for itself in a short time even though, as the first of its kind it was expensive to build. Under the best conditions, top down, hard, level road and at a speed of 20 miles per hour a mileage of 28 miles per gallon was obtained.

Aside from increasing the efficiency of the engine as a whole, the device seems to have possibilities as a dust separator. Inspections showed that the fan blades were scoured clean and bright, and several ounces of dust were removed from the vaporizing chamber after 10,000 miles of operation. The dust was freed from its bond of petroleum coke by heating the whole casting to a bright red heat for several hours.

The automobile is still young and oil fuel is still plentiful. Just how long before the average American will complain of gasoline prices as he now does of railroad fares is a big question. However, when the American pays a dollar a gallon for gasoline, our motors will take us 60 miles per gallon instead of 60 miles per hour.

The Engineer and Summer Work

The twelve month curriculum of the engineer, while not known by that name, has in recent years become an established course for most of the students of the technical schools of this country. Instead of confining the training to nine months in the class rooms and laboratories, an additional three months in the field, shop or commercial drafting room has been added to the work of a majority of the undergraduate engineers. An investigation of the kind of work done gives some clue to the propelling motives for such a schedule of training.

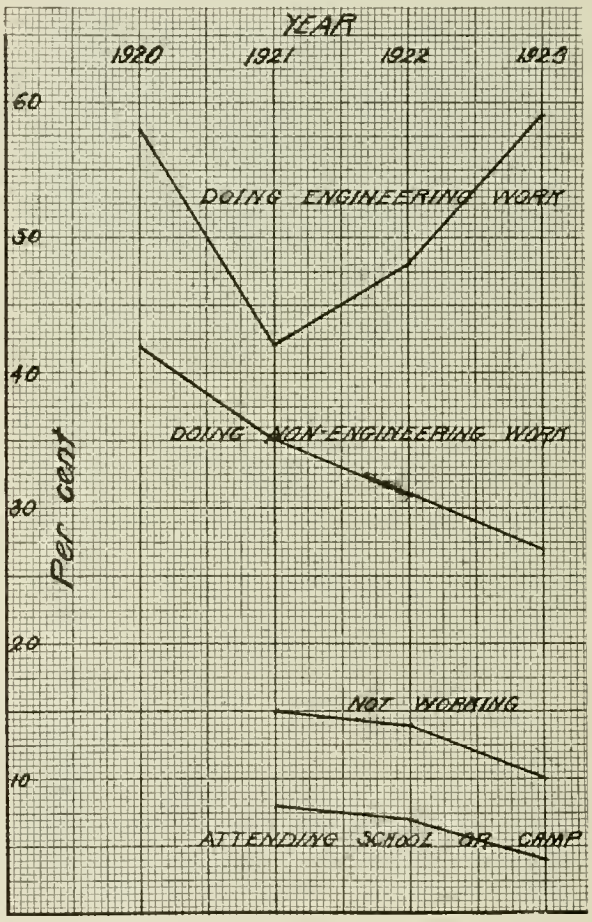
Why do so many of the engineers work during the summer? In answering this there appear two distinct reasons, although numerous others could be found by considering individual cases. The first and probably the foremost is the result of necessity, while the second comes through the recognition of the importance of practical experience in engineering work before graduation.

It naturally follows that for the former group the primary object is the accumulation of as much money as possible in the short period of time available. These will, of course, go into the type of work that will be the most lucrative to them and many will find engineering work their best field. The later class, who desire to obtain practical working knowledge of their chosen field, will select some form of work allied with their line of study.

To provide these men with suitable jobs in engineering work is the purpose of the committee on summer employment for undergraduates in the college of engineering. In order to accomplish this inquiries are sent to a number of companies that may be able to provide the work desired as to whether they will be able to take on students for the summer. The records of this committee show that in 1923 there were 712 jobs available for students in civil, electrical, mechanical, mining and railway engineering, no report being given for the other departments of the college. However, there were a large number not dependent on the efforts of the committee to obtain work; and, of the 724 men who reported last September as having been engaged in some form of work of value in engineering and architectural training during the past summer, only 80 had been dependent on the committee to supply jobs.

Another of the chief aims of this employment committee is to encourage the engineers to go into work that will later prove of benefit to them. To what extent they have been successful along this line can best be judged by studying the last report.

According to their records the students of the college of engineering may be classified in two major groups, either as those who work during the summer or those who do not. The former is by far the larger class and is subdivided into those engaged in engineering work and those doing non-engineering work. For those who do not work the number is split between the few not working and those who attend summer school or camp. The



data compiled from the questionaires filled out at the time of registration in the fall gives a basis for several conclusions; and is as follows:

A graph plotting the percentage of the number reporting against the different years probably brings out the most interesting results. During the past four years that the committee has been functioning it appears that the aim for which it is working is gradually being accomplished. The graph shows that the number doing non-engineering work as well as those not working has been steadily decreasing. The percentage of those doing

(Continued on Page 220)

August Ziesing

H. E. Hiles, c.e., '25

If many of our prominent engineers included on their office staff a skilled personal publicity director, as is the practice of politicians and actors, the world would soon be aghast at the miracles man has wrought to overcome the obstacles of nature. But since this department is usually neglected by the leading engineers of the country many of them are practically unknown outside of their own field, and are able to work in comparative peace. August Ziesing is just such an engineer; known of by a relatively small number, he is the head of probably the greatest engineering and fabricating company in the world—the American Bridge Company.

He is typical of most of our most successful engineers: a quiet, energetic and hard worker, who knows his work thoroughly, who gets results. These are the factors that have given him power and self-reliance in tackling some of the largest problems, not only in bridge and railway construction, but also in the design of tall structures.

Illinois can well point with pride to August Ziesing as a typical example of the middle western product. He was born, reared and educated in this state and state institutions. His boyhood days were spent in Peru, Illinois, from the time of his birth, February 19, 1858, until he entered the University. He received an elementary school education and after some private tutoring he started his university course. He was graduated with the class of 1878 in mechanical engineering, in which class their were only nineteen graduates.

After graduation he engaged in bridge designing and construction; but in 1881 he changed to railway engineering, in which he stayed for two years. Then, only five years after graduation, he was made manager and engineer of the Lassig Bridge Works. Soon after this, February 29, 1884, he married Alice A. Hanna of Wooster, Ohio. It was during this time, as manager of the Lassig Bridge Works, that Ziesing gained the reputation which later secured for himself the presidency of the American Bridge Company. In 1897 he started in business for himself as a consulting engineer, specializing in bridge and railway structures. He was engaged in this for five years, and then was made vice-president and western manager for the American Bridge Company. In 1905 he was promoted to the presidency of the organization. In 1905 he received an honorary degree from the University, in civil engineering.

August Ziesing belongs to a number of clubs and societies but he has little time to attend meetings and mix in society. He is a member of the following engineering societies: American Society of Civil Engineers, Western Society of Engineers, and the American Railway Engineering Association. He is also a member of the following other clubs and societies: University Club, Union League, Engineer's Club of Chicago, Skokie Country (Glencoe),

August Ziesing

Engineering Club of New York, Duquesne and Pittsburgh Athletic, Delta Tau Delta and Sigma Tau. He has three daughters, all of whom are married; and one son, Henry Hanna Ziesing, also a graduate of Illinois, in the civil engineering class of 1908. August Ziesing now lives at Glencoe, Illinois, is sixty-six years old; and still doing active work in the business of which he has been president for the last nineteen years.

Any note on the life of this man would be incomplete without some mention of the American Bridge Company and a few of the best known constructions jobs that it has handled. This organization has contracting offices systematically located over the United States in twenty-five of the largest cities; and fabricating and construction plants at

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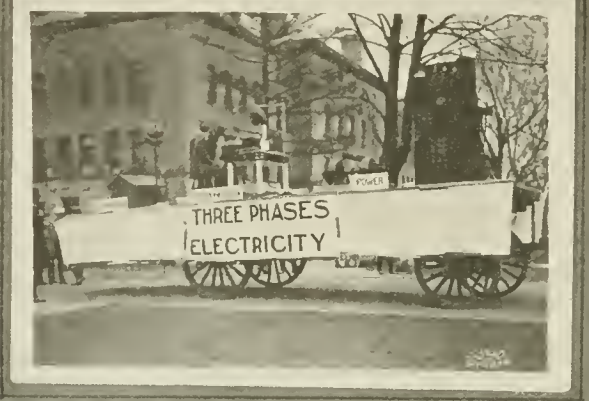
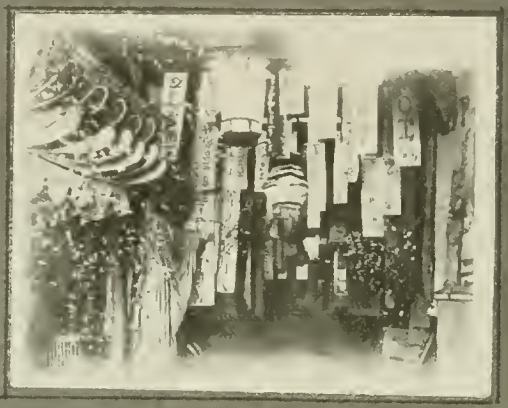


~ ELECTRICAL ENGINEER'S FLOAT ~

~ CIVIL ENGINEER'S FLOAT ~

UNIVERSITY
of
ILLINOIS



ENGINEER'S
DAY
APRIL 4 1924

~ 1924 ARCH FETE ~

~ MINING ENGINEER'S FLOAT ~

~ 1924 ELECTRICAL SHOW ~

~ GENERAL ENGINEERS FLOAT ~

~ CERAMIC ENGINEER'S FLOAT ~

Engineers' Day

C. H. Dodge, min.e., '24

Friday, April 4, 1924, will live in the minds of the students and faculty of the college of engineering as the first successful Engineers' Day to be held at the University of Illinois. Attempts have been made in the past to set aside a day of the college calendar as a time when the student engineers and their faculty could lay aside laboratory cares and daily mental gymnastics and gather together in "holiday" spirit to pay homage to the engineer, but it was not until this year that the enthusiastic, co-operative and untiring efforts of the engineers "put the event over" and left the word success stamped on the result.

Every college, as a collective body, has an inherent desire to "show off" the merits of itself to the students and faculty of the other colleges. This ambition materialized in Engineers' Day. The desire permeated not only the college of engineering as whole but every department as expressed in the float which each department constructed to portray the particular field that it embraced.

Classes in the college of engineering were dismissed at two-fifty. Promptly at three o'clock, with ideal weather conditions prevailing, came the warning blasts from the whistle of the minature power station on the mechanical engineers' float and the engineers got under way. An engineers' band of fifty pieces led the procession followed by a military escort composed of regular army officers of the engineers unit of the University R. O. T. C. and a detail of student officers.

Dean Milo S. Ketchum of the College of Engineering and Dr. I. O. Baker, Professor Emeritus of civil engineering, speaker of the day, were next in line. Following them were over one thousand engineering students and faculty members who marched in file behind the floats of their respective departments.

Hundreds of spectators gathered along the line of march and cheered from campus buildings as the parade with its eight floats wound its way through the streets and campus. The architects were first in line with their float representing a miniature reproduction of the Acropolis. Next came a twenty-foot spandrel concrete arch bridge constructed by the civil engineers. Following came the model steam power station of the mechanical engineers. An exact replica of the famous Eddystone lighthouse, which stands guard in the English channel, was the contribution of the general engineers. The electrical engineers float which followed showed the three phases of their profession: power, illumination, and communication, featuring a radio setup that received music broadcasted from the electrical engineering laboratory.

The winning float by the department of mining engineering was next in line. It depicted the three divisions in mining: coal, metal and metallurgy. The railway engineers display showed a locomotive dominating the globe on which it rode. The ceramists float completed the parade with a large pottery kiln and a display of clay products. The procession proceeded through the University district and campus to the auditorium where it disbanded for the engineering convocation.

The convocation is an annual event which has been fostered for the purpose of promoting better acquaintanceship among the students of all departments. Dean Ketchum presented Professor Ira O. Baker as the speaker of the day. Professor Baker included in his address the history of the engineering profession, enumerated some of its most recent achievements, and presented the future of the field of engineering in glowing colors. Professor Baker urged the students to remember that they are primarily members of the social body and that they should not retire into the technical recesses of professional work.

As a part of the "holiday" program the faculty held their annual Jollification dinner at the Urbana-Lincoln hotel. From information that leaked out the entertainment was enjoyed by all, even the 'roasted.'

No celebration would be complete without a dance and the Engineers Dance brought the day to a close. With transits, levels, rods, and stakes swung over masculine shoulders three hundred engineers and their partners enjoyed a unique and novel grand march. The orchestra in the field duty attire of engineers added to the tone of the occasion.

A four page dirt sheet, the Engineers Dance News, appeared during the middle of the evening to spread scandal on many of those present. Engineering exhibits from the different departments were displayed in the booths.

No large scale affair can be successfully staged without the active aid of all concerned and the thorough planning and directing of a few. This year's celebration was directed by a committee of

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Coal Dust Hazards

L. D. Tracey, B.S., E.M.
U. S. Bureau of Mines, University of Illinois

Since the introduction of pulverized coal as a substitute fuel for natural gas in the various types of heating furnaces used in steel mills, a number of fires and explosions have occurred, resulting in the loss of life and property.

As one of the primary functions of the Bureau of Mines is to conduct investigations in the utlization of mineral substances with a view to increasing safety in the use thereof, it was deemed advisable to investigate the hazards involved in the industrial use of pulverized coal and, if possible, to devise methods of preventing accidents arising therefrom. The knowledge of the explosive qualities of coal dust which the Bureau has gained in studies effecting dust explosions in coal mines was of material assistance in these investigations.

Several plants were visited in which either fires or explosions had occurred, and data obtained as to the probable cause of these accidents. There was found to exist, among some of those employed about the furnaces, a lack of knolwedge of the explosive and inflammable qualities of powdered coal.

A small stream of pulverized coal leaking down from a defective joint in a coal transport line did not attract much attention, whereas, had a leak in a natural gas line occurred under similar circumstances, no doubt it would have had immediate attention.

As a matter of fact, if by any means the dust cloud should come in contact with an open flame or hot metal, the effects would be as disastrous as if it had been gas. Figure 1 shows the tremendous explosive effect of coal when ignited. In this test, a heavy body of dust was suddenly expelled by compressed air from its cylinder which was in contact with burning oil-waste. This ignited the dust and illustrated the expansive and burning power which, if confined, could reap havoc and death in its path.

One of the accidents which has come to the writer's attention may better illustrate this. In a system used at this particular plant, the pulverized coal is transported to the furnace through compressed-air lines. The fuel is fed from a storage bin to a blowing tank in quantities as desired, after which compressed air is admitted and the powdered coal is blown to the furnaces. At the time of the accident some repairs were being made to the tank, and it was supposed that the air-pressure had been entirely released as the pressure gage stood at zero. There was, however, one or two pounds air pressure remaining and when one of the connections was taken off, a cloud of dust was blown across the room, 30 to 40 feet, towards the drier furnace where it came in contact with some live coals. Immediately the entire room was filled with flame which rolled back and forth over a space of 60 feet or so in length.

It would seem desirable, as regards safety, if the management of all industrial plants in which pulverized coal is used for fuel, and especially of those plants in which heating and annealing furnaces are installed, would impress upon their employees the fact that clouds of fine coal dust are as dangerous as a body of unconfined natural gas,

Fig. 1. Explosive Effect of Coal Dust

if the dust is liberated in close proximity to an open flame or mass of red-hot material.

In the tests made of coal-dust explosions in the experimental mine of the Bureau of Mines, pressures as high as 130 pounds per square inch have been recorded. Such pressures are, obtained, however, only when the explosion has traversed some distance through the confined passageways of the mine. A somewhat analogous condition might be

noted in an instance which came under the writer's observation. Coal dust was undoubtedly ignited in a pulverized-coal transport-line of spiral rivetted pipe quite some distance from the fan furnishing the propelling air-current. The pipe line confined the explosion until it reached the fan, when the cast-iron casing was completely shattered. Experiments have also demonstrated the fact that a mixture of 30 per cent pulverized coal-dust and 70 per cent of finely powdered shale is explosive. These tests are applicable to the conditions that may be found in industrial plants, as they serve to show that the coal dust which may have settled on the floors and girders of the building is not necessarily rendered inert by the incombustible matter with which it may have become mixed.

Analyses of dust collected from the interior of mill buildings in which are situated furnaces using pulverized coal have shown that the dust sometimes contains as high as 23 1-2 per cent volatile matter, only a little lower than pure Pittsburg coal.

One of the most serious troubles with which users of pulverized coal have had to contend has been the number of fires in the storage bins for pulverized coal. It has been somewhat difficult to determine the exact cause of these fires, but, undoubtedly, spontaneous combustion has played an important part in the origin of some of them. It is obvious that coal, when finely powdered, presents a much larger surface and a much larger quantity of coal to contact oxygen than when in solid masses.

"The rate of absorption of oxygen increases so greatly with rise in temperature that the warming of coal by a steam pipe or boiler may enormously shorten the time necessary for spontaneous combustion or render spontaneous combustion possible in cases where it would otherwise be impossible."

The attached chart shows the rate of oxidation of Illinois coal (ground to the finess of 80 to 100 mesh) at different temperatures. It will be noted that at a temperature of about 150° F. the rate of oxidation is very rapid.

As the amount of heat generated in coal is in proportion to the amount of oxygen absorbed, it is reasonable to assume that if enough air is present, pulverized coal when delivered to a storage bin at a fairly high temperature, will in a short time approach the point of ignition.

In some of the systems used in drying and pulverizing coal, the fine coal, about 90 per cent of which will pass a 100-mesh screen and 70 per cent a 200-mesh screen, is delivered to the storage bins at a temperature of 125° to 130° F. It is possible however, for the person running the drier to permit the fire to become hotter than normal and thus overheat the coal in the drier. Such an instance has been brought to the attention of the Bureau. In this case a pyrometer placed in the end of the drier normally registered a temperature of 150° F. but at the time of the explosion in the pulverizing house, a temperature of 350° F. was registered.

Fig. 2. Effect of Coal Dust Explosion

When the drier becomes overheated, the coal may be delivered to the storage bins at a temperature of or above 150° F. If left in the bin for a comparatively short time, it is very probable that the temperature of the coal will rise to such a point that when mixed with air the coal will burn rapidly.

Overheating of the coal is especially liable to happen in the type of drier commonly known as "direct heat" drier, in which the gases from the combustion chamber pass directly through the center of the drum and come in contact with the coal passing through. Particularly is this true if for any reason the drier should stop running, while at the same time the fire on the grates is permitted to continue burning.

In connection with the above-mentioned hazards, the following suggestions may not seem out of place. Care should be taken that the pulverized coal is not delivered to storage bins at a high temperature; and to avoid this the gases of combustion from the drier furnace should not be allowed to become hot enough to overheat the coal. In "direct heaters," the fire should be so maintained that red-hot cinders

will not drop into the screw conveyor feeding the pulverizer. The entire safety of the pulverizing plant largely depends upon the man tending the fire in the drier. If he is careless and builds a big fire on the grate, the chances for overheating the

FIGURE 1.-- CHART SHOWING RATE OF OXIDATION OF ILLINOIS COAL AT DIFFERENT TEMPERATURES.

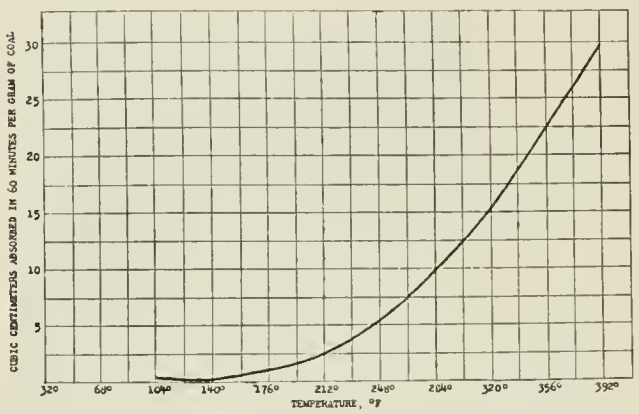


FIG. C.. RATE OF OXIDATION OF COAL AT DIFFERENT TEMPERATURES

coal in the drier are very great. Or, if he should stop the operation of the drier and at the same time maintain a hot fire, hot coal will result, which might be carried to the pulverizer. Such carelessness would probably result in a disastrous explosion.

Storage bins for pulverized coal should not be placed in any position where they may become overheated from furnaces, steam pipes or flues.

If a plant has been shut down for several days, delivery of coal from the storage bins through transport lines to the place of consumption should not be permitted before an examination is made to ascertain whether the coal has become overheated to such a point that it will ignite when brought in contact with a current or blast of air. This can be done by pushing rods into the interior of the stored coal and leaving them there a short time. When they are withdrawn, the temperature of the rods will indicate whether or not there is any fire or overheating in the bin.

It is believed that the spontaneous combustion of the coal in the storage bin is partly responsible for some of the fires that have occurred in the transport lines which convey the pulverized coal from either the main pulverizing plant or a sub-station to the furnace.

A number of cases have been investigated in which almost without warning, flames burst from the coal lines, when apparently everything has been running smoothly; no stoppage in the lines or in the burners having been observed. However, on several occasions fires have been discovered in the pulverized coal storage bins.

It seems perfectly reasonable to suppose that the coal in the bins had become heated by spontaneous combustion to almost the ignition point, and when this heated coal was conveyed to the transport line, the air from the fan producing the circulating current supplied enough additional oxygen to produce incandescence which, in turn, ignited the dust cloud passing through the line. The reason that an explosion did not immediately take place is not definitely known, but is attributed to the excess of coal dust in the line over the amount of air present. In fact, in one instance, an explosion which wrecked the line did occur at a point just beyond a feed line to the furnace where there was a much leaner mixture of air and dust than at the point where the line was simply burned out.

That an exceedingly dense cloud of coal dust may come in contact with a flame and not ignite had been demonstrated in the laboratories of the bureau. A cloud formed by two ounces of pulverized coal and one cubic foot of air was suddenly brought in contact with a ball of burning oil-soaked waste and a lighted candle, with the result that the flames in the waste and the flame of the candle were both extinguished. In superdusting experiments carried on at the experimental mine of the bureau by George S. Rice, it was observed that a dense cloud of coal dust on coming in contact with a flame at the point of ignition blanketed the flame. However, if the same dust cloud were raised at a point where only a part of the cloud came in contact with the flame, there is a possibility that an explosion would occur. In other words, the pace of an explosion depends upon the quantity needed for propagation.

From the above-mentioned tests it would seem reasonable to assume that whether an explosion takes place or whether the powdered coal in the line burns without violence when red-hot particles are introduced into the pipe lines depends largely upon the density of the dust cloud at that particular time.

Some of the fires that have occurred in the powdered coal distribution lines in several plants have undoubtedly originated from "back fires" from the heating furnaces. These, unquestionably, may be caused by the air pressure in the distribution line suddenly dropping below the secondary air pressures. By secondary air is meant the additional air supply provided by blowers or otherwise to furnish oxygen for proper combustion in the furnaces.

The drop in pressure is due to several causes; the fan that furnishes the air current for transporting the coal may be suddenly stopped, the air current may be interrupted by an obstruction in the transport line, or the opening in the burner may be-

(Continued on Page 208)

Warm Air Heating Research Residence

A. C. Willard
Professor of Mechanical Engineering

In a convention at the University, December 4, 1923, the National Warm Air Heating and Ventilating Association made available a fund of $25,000 for the construction and equipment of a residence for experimental work in warm air heating. This association, composed of manufacturers of warm air furnaces and accessory equipment, has co-operated with the Engineering Experiment Station since 1918 in an Investigation of Warm Air Furnaces and Heating Systems, and has contributed to this investigation about $6,000 annually. The results of the investigations are contained in four Engineering Experiment Station Bulletins, numbers 112, 117, 120 and 141. The last bulletin, number 141, is a very complete exposition of actual test results. Heretofore the work has been done entirely in the mechanical engineering laboratory but with the acquisition of the residence a new field of investigation will exist. The experimental residence will be known officially as the Educational Research Residence of the National Warm Air Heating and Ventilating Association. Property has been purchased and construction of the residence is well under way. It will be located one block from the University High School, on Stoughton street, Urbana. The accompanying architect's perspective of the residence and the floor plans convey an impression of the high character of the residence. Examination of the plans will show the variety of possibilities for which the residence was planned. Large and small rooms, sun room, remote rooms, rooms exposed on three sides, first, second and third floor rooms, inside and outside exposed chimneys with lined and unlined flues, are all incorporated in one structure. It may be of interest to outline the purposes for which the residence may be used.

Professor A. C. Willard

First of all, operating tests of a furnace heating system conducted in such a house will make it possible to compare and correlate the results of tests of furnaces which are now being made in the laboratory with the results obtained on the same furnace under actual house conditions. It has been suggested from time to time that the furnace efficiency, capacity, and general performance as found in the laboratory might be different from that which would be obtained in a house installation. The research house will make such comparisons possible and positive.

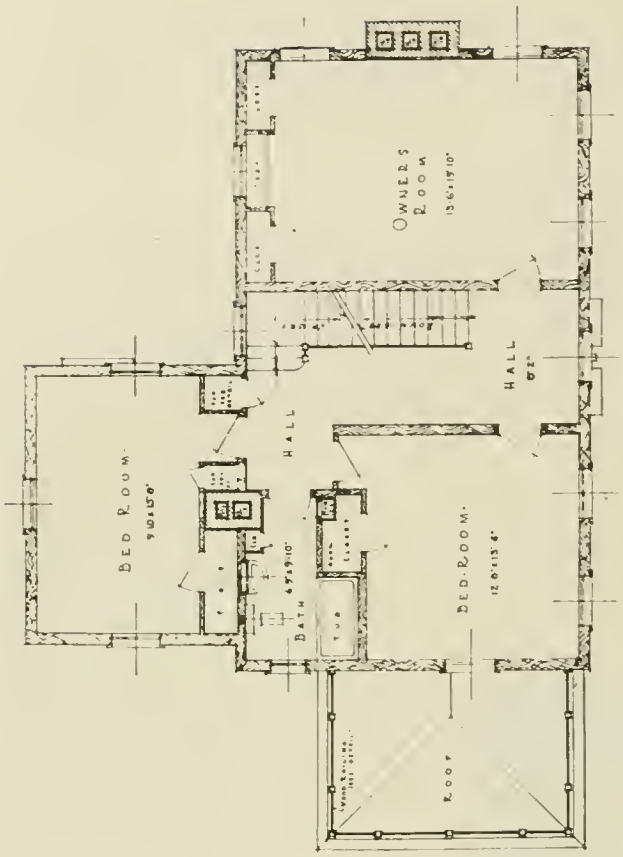
There are certain performance factors of vital interest to the manufacturer and installer which we cannot determine in the laboratory. Some of these are:

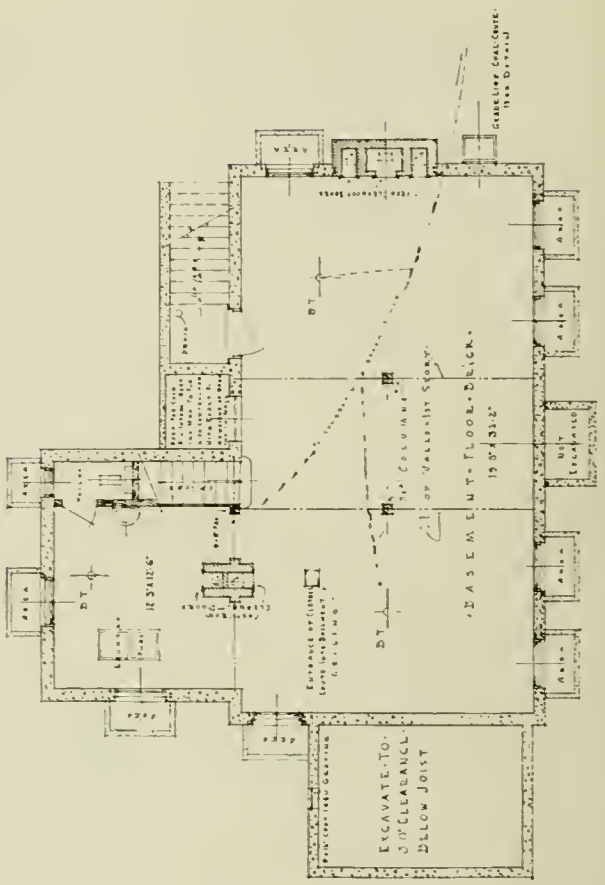
(1) The effect of wind on the proper circulation of the air to those rooms which are on the windward side of the house. The study of this problem will develop the true value of tight windows, double sash and metal weather strips in furnace heating.

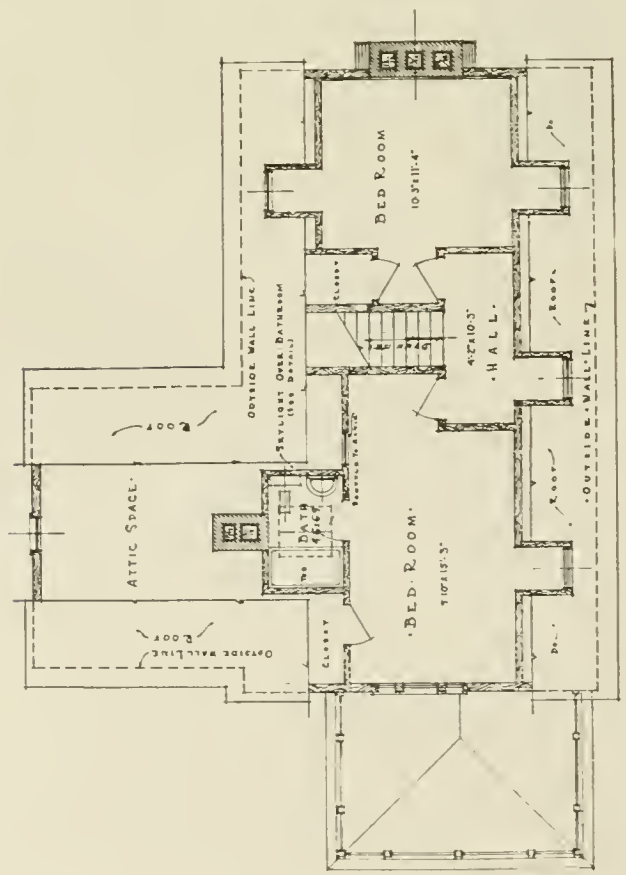
(2) The relative value of inside and outside air supply to the furnace. It has been stated many times that a material saving in fuel results from using all inside air, that is, recirculating the air in the house, instead of taking cold air from outside directly into the furnace. How large is this saving? Do the actual savings, if any, check with the computed savings? Outside air supply may result in a better operating head since this air is colder than air recirculated from the house. Are smaller pipes possible as a result of this increased head?

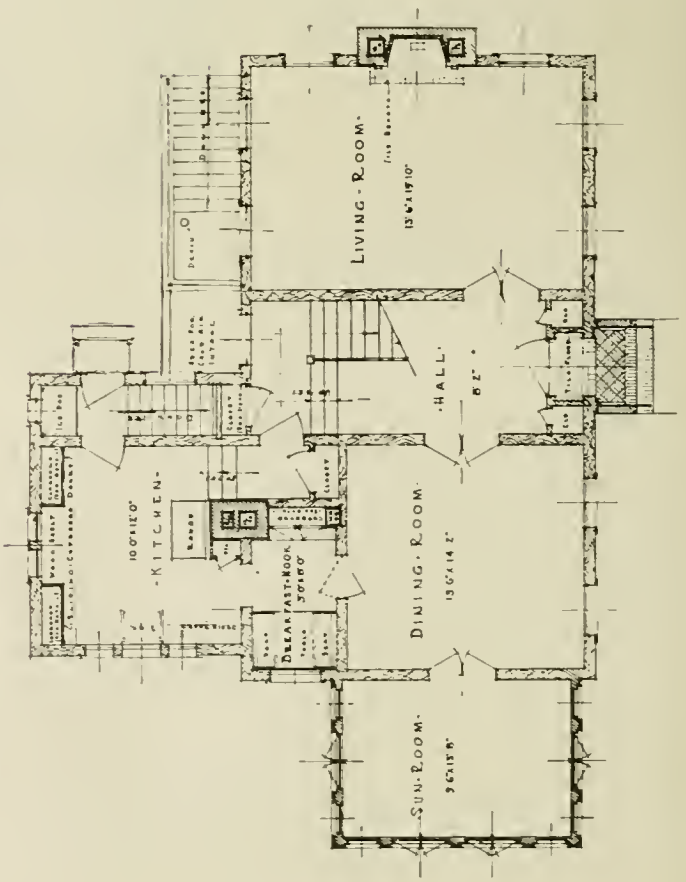
(3) The importance of and the proper degree of humidity which should be maintained in a furnace heated house. Does a reasonable relative humidity make it possible to carry a lower air temperature in the house with comfort? Does this condition actually result in a saving of fuel or not? Can you properly and successfully humidify houses with windows of single glass which are often not tight, so that the water vapor is lost as fast as supplied by the humidifier, or must you use double sash or weather strips to stop some of the leaks and prevent condensation on the cold glass?

(4) The effect of outside cold walls on air circulation and the temperature variation from floor to ceiling in actual rooms. It is well known that there is a great difference in heating systems in respect to the range in temperatures between floor and ceiling. Direct radiators in a room with much cold outside wall may create a large difference in


OWNERS ROOM
HALL
BED ROOM
BATH
BED-ROOM
ROOF


BASEMENT-FLOOR-PLAN
EXCAVATE-TO-6'0" CLEARANCE-BELOW JOIST


BED ROOM
HALL
ATTIC SPACE
BED-ROOM
OUTSIDE WALL LINE
ROOF


LIVING-ROOM
HALL
KITCHEN
BREAKFAST-NOOK
DINING-ROOM
SUN-ROOM

temperature between floor and ceiling, and yet maintain a satisfactory breathing line temperature. *Hot-air* furnace systems do just the same thing. At what air temperature at the inlet registers to a room do these temperature differences become serious?

(5) Effect of location of warm air furnace in the basement on the successful heating of the house. Is a location to the north and west, or favoring the worst exposure as important as it would seem, or would a more central location do as well or better?

(6) Effect of return air ducts below the floor entering a pit under the furnace, as compared with return air ducts run above the floor and entering casing above the base ring. Does the extra operating head really give any advantage when the additional length of duct and extra elbows are taken into account?

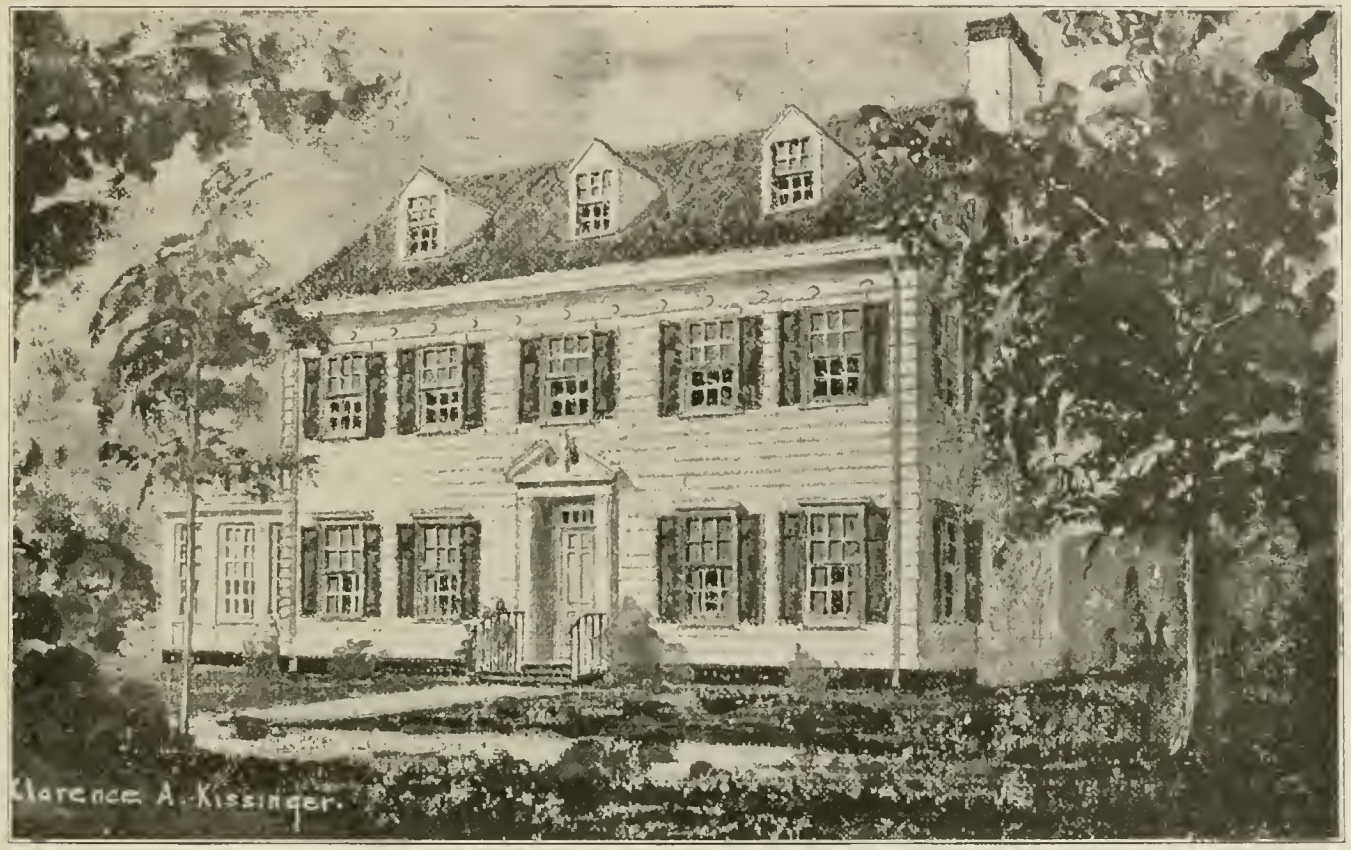
(7) Proper location and arrangement of the register or registers for recirculated air in a system using all inside air. This item is a very important one and may vitally affect the success of any recirculating system. Some of the conditions which should be studied are merely mentioned in the following:

Effect of location of cold air return register:

(a) in hallway, (b) near outside wall, (c) with two or more on first floor, (d) for two-story (2 family) house, (e) with trenched return, (f) with boxed joist returns, (g) with return registers in side wall, (h) with outside air supply.

(8) Effect on heating of any room of the location of the warm air inlet registers. In the case of first floor rooms there are at least three possible locations:

(a) In the floor, (b) in the baseboard, (c) in the side wall, either high or low.



Research Residence of the National Warm Air Heating and Ventilating Association Being Built at Urbana

In the case of second floor rooms there are usually two possible locations:

(a) In the baseboard, (b) in the side wall just above baseboard.

A register placed high in the side wall of a first floor room may solve a difficult problem and at the same time materially increase the flow of air and heat to the room. How much is the increase in a given room for such a register location?

(9) Effect of installation details on the operation of wall stacks to second and third floors. In this case we already have a great deal of data from laboratory tests, but as was stated at the beginning, it is most essential that we correlate these data with results obtained in an actual installation. The details which require study are:

(a) Best and most practical ratio of stack area to leader area; (b) limitations of studding spaces,

(Continued on Page 214)

History of Surveying Instruments

T. W. Oliver, c.e., '25

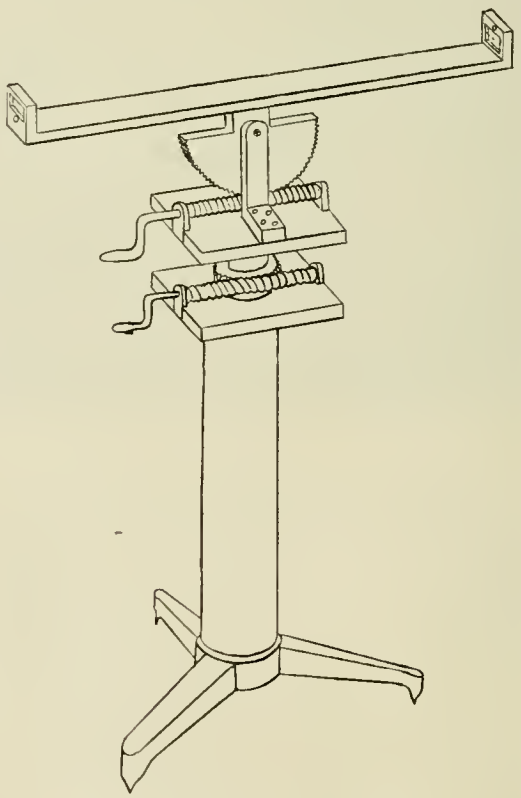
The subject with which this paper is concerned is extremely difficult to handle in the narrow confines of this article. The whole history of early surveying art is shrouded with the obscurity that ever accompanies the passing of the centuries. The seeker for knowledge finds clues of all sorts, often of conflicting nature, and it is difficult to assign to each its relative weight or value. It is enlightening to follow an elaborate idea back through successive writers. One is forced to strip from it trimming after trimming, until at last there remains but a plain ungarnished fact which may have no significance whatsoever. Therefore the writer does not pretend to anything absolute in this article. Only those things are presented which seem in the main, accordant with the general trend of the development of surveying art through the years.

From what is now known, but little as to whether or not the ancient possessed land surveying instruments can be affirmed. The destruction of the Alexandrian libraries, where such information was probablly recorded, has put it beyond our power to determine if such instruments actually existed. But we do have some tangible evidence, for sculptured and painted figures on the walls of an Egyptian copper mine (4,000 B. C.) show us that the art of mine-surveying was practised at a very early period in the world's history. This is also substantiated by the existence in Turin of a papyrus giving the plan of an Egyptian gold mine of about 1,400 B. C. Land surveying might have been practised by the early Egyptians because the annual overflow of the Nile with its consequent deposit of mud probably obliterated all boundaries thus making yearly relocation necessary. This too is born out by the existence of a papyrus (1700 B. C.) in the British Museum, which gives rules for the solution of geometrical problems, among them the finding of the areas of triangles, circles and trapezoids.

Mention might be made here of a fact which was possibly employed by the very earliest of Egyptians, namely, the knowledge of the ratio, 3 : 4 : 5, and its geometrical significance. This device was employed by the Greeks for setting out long lines at right angles to each other, and was done stretching ropes about pegs in the ground. But they learned of this from the Egyptians of their time, for Democritus considered the Egyptian "Rope-Stretchers" as they were then called, the masters of Geometry.

From that time (470 B. C.) until the time of Hero of Alexandria (285-222 B. C.) but little is recorded. However, it is here that the first real surveying instrument appeared. Sometime during this period, the Groma was developed, for Hero writes that it was made by men before his time. This instrument consisted of two horizontal arms set at right angles to each other and equipped with a device for sighting, the whole being mounted upon a single vertical staff, so that it was much like a cross-staff in appearance.

Hero made many improvements upon this simple instrument, and by him the improved apparatus is called the "Dioptra." In fact, Hero in his writings, which are still extant, gives specific instruction as to the minute details of the construction of the



The Dioptra by Hero (About 250 B. C.)

dioptra, and its employment in the solution of such problems as sinking a shaft to strike a given tunnel, making tunnels from opposite sides of a mountain meet, finding of an inaccessible height, or the distance across a wide stream. This last seemed to be a favorite problem of the Greek geometers, each having his own pet solution. Needless to say,

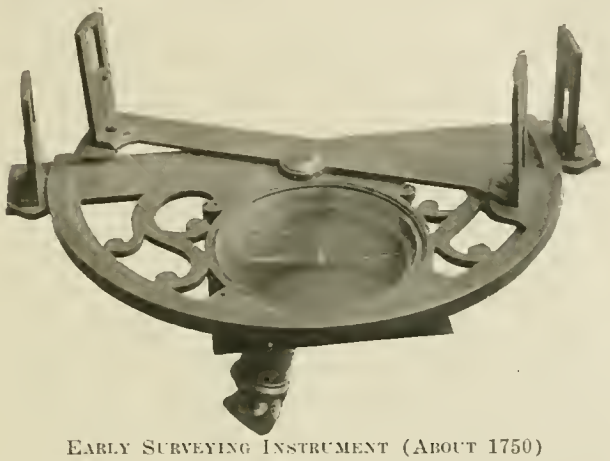
each solution was based on the similarity of triangles. Hero claims ease of solution of these problems with his improved dioptra and this is readily accorded when one knows the construction of the instrument.

The dioptra seems to have consisted of a flat brass rod about eight feet long, provided with sights at each end and supported upon a pillar which could be brought to a perpendicular by means of a plummet hanging by its side. The rod could be adjusted to a horizontal by means of a water-level applied to its side. This sighting rod was not immediately fastened to the pillar, but was mounted upon two ingenious screw mechanisms, devised to allow the rotation of the rod horizontally, and to a lesser degree, vertically. Right angles were set out by means of a second rod placed at right angles to the first, the principle of the Groma, or by means of a stop or button in one of the screws which stopped the horizontal motion of the rod when it had revolved through exactly ninety degrees. For use with the dioptra, two rods or poles were provided which closely resembled the improved leveling rods of today. These were about twenty feet long, and were provided with a slide, which, by means of a string, could be raised until the total heigth of the rod was about forty feet. Fastened to the slide was a circular target, colored half black, half white, and gradnations were marked upon the rod. The manner of employment of the dioptra and rods is obvious, and from the writings of Vitruvius (First century B. C.), it is evident that the Romans adopted it for all nice calculations and for laying out the right angled streets and divisions of the Roman military camp.

Whether or not this instrument was generally used during later times is not known. Probably some sort of a cross-staff arrangement was used. But it must be conceded that this rude instrument was the fore-runner of the modern highly developed theodolite or transit instrument.

The measurement of other than right angles seems not to have been practised during these times by the Greeks or Romans, except in the field of astronomy, and then not until the time of Ptolemy, though he derived the practise from Hipparchus. Even the great Antanionius seems to have had no method of determining the directions of the various roads in the provinces conquered by the Romans, though on his map he gives the distances between important points in Roman miles, determined, no doubt, by pacing, which was the common method of measuring distances in those days.

At this period a sort of a leveling device was in use which was constructed as follows: The instrument consisted of a long horizontal bar in which was placed a metallic tube running the full length of the bar. Glass cylinders were placed at right angles to each end of the metallic tube and connected thereto. These glass cylinders were provided with vertical plates which could be raised or lowered by screws, and these plates were slotted horizontally to permit sighting. Evidently the affair was filled with water so that it stood in each of the glass cylinders at the ends. The plates were then moved vertically until the slots came opposite the water level and thus a level line was determined.



Early Surveying Instrument (About 1750)

This device or a similar one may have been combined with the dioptra, but the evidence on this last is very uncertain.

Between Roman and Mediaeval times there exists another gap in our history, similar to that which exists between Egyptian and Greek times. And just as in that gap of time the Groma devoloped, likewise in this gap the compass appeared.

It is affirmed that Marco Polo, in the year 1295, brought it from Cathay to Italy, and that some fifteen years later it was mounted in box form by one Flavio Giajia of Amalfi. Other authorities have it that the first authentic mention of the compass was by Alexander Neckham, an Englishman who died in 1217, and that the first tangible description of the compass was in a letter to Petrus Perigrinus De Maricourt, written in 1269. This last mentioned compass was divided into four quadrants of ninety degrees each. However the first mention of the compass as applied to surveying seems to have been in an anonymous German work on mining, published in the year 1505. Several copies of this book are in the library of the Freiburg Mining Academy. Agricola, in his "Re De Metallica" (1548) mentions the "Setzcompass" which seems to have been used extensively in mining surveying at this time. This consisted of a circular wooden block, into which concentric circular grooves were cut and filled with colored wax. The center of the block was hol-

(Continued on Page 210)

Importance of Study of English

H. H. Smith, e.e., '24

"An engineer is *not* a business man."

This seems to be the idea of the general public, when the leadership of important works is considered. That this impression has taken a strong hold among people connected with governmental enterprises, in particular, is shown by the following phrases included in a public statement made by Secretary of the Interior, Work, in commenting on certain recent changes in the personnel of the Bureau of Reclamation. He says that while the ability of the engineer is "primarily essential to construct dams and ditches" the problems later encountered in the administration and operation of the Bureau can be "best handled by a practical business man."

In other words, a great many people think that while an engineer is indispensable in the carrying out of important public works, the nature of his training and ability does not fit him to become the executive head of the organization, as well as a politician or a lawyer. The "business man" is to be the general manager, while the engineer is merely a "hired man" who is to carry out the program laid out by his superior.

This feeling has been recognized and much has been said about the training of young engineers to take a more active part in public affairs, to the end that engineers be recognized as men capable of handling the more important aspects of the enterprises with which they are associated. Indeed, it has become quite popular to preach to them about the necessity of taking a more prominent part in social activities for that reason.

Turn to almost any periodical dealing with engineering subjects, engineers' professional relations, and the like, and you will find an article urging young engineers to identify themselves with the civic affairs of their community.

But too often such articles deal merely in glittering generalities, and do not give any real help to the persons addressed. The need now is not so much to create a desire, as to give some more definite suggestions as to how to attain the end that they so much desire.

Dr. Thomas T. Read, who was formerly Supervising Mining Engineer of the United States Bureau of Mines, in speaking before the last annual convention of the American Association of Engineers, said: "The proper way in which to exercise authority is to inform and convince people of what ought to be done, because if they are informed and convinced, they will do it without any compulsion." But here lies the difficulty, perhaps, that bars many engineers from exercising the authority that should belong to them by virtue of their ability and importance in the modern world.

Most engineers lack the ability to "inform and convince" because they cannot express themselves in clear and forceful language. It is not enough to be able to state facts plainly, but a man must be able to put forth his ideas in such a form that they are not only easy to understand, but are in addition interesting enough to attract the attention of the people he desires to reach.

It is not as hard to reach the goal as it might seem. No man intelligent enough to be an engineer is unable to speak grammatically correct English. If he is careful, he can avoid the pitfalls of the split infinitive, the dangling participle, and other horrors of the grammarian. The difficulty lies not so much in how to talk and write, as in what to talk and write about.

There is no short-cut to facility in writing, however. Practice is very necessary to reach perfection in anything. Let a young engineer that is interested in the work he is doing, or in some particular phase of an engineering job, pick out some striking thing about it and try writing a short article to be published in the local newspaper. He may not be successful the first few times, but if he will study to pick out some interesting thing that will be of interest to the general public, and not get too technical, the articles will get better, and eventually be printed. And he will be surprised at the results. Aside from the mild notoriety he will get, he will have an increasing feeling that he can put his ideas across.

After all, there is not such a vast difference between building a bridge of steel and concrete from one side of a river to the other, and building a bridge of words and ideas from one mind to another. If a man can study the properties of materials and construct a material bridge that will do what it is expected to do, he can study the properties of language and construct an intellectual bridge that will reach out and unite men as it is expected to do.

And then, with misunderstanding cleared away, it will be possible for men to see that, essentially,

"An engineer *is* a real business man."

Cement Packing

W. S. Clayton, c.e., '25

This article was selected from the papers required by Chi Epsilon of its pledges.—Editor.

Years ago the barrel was an almost universal container. Sugar, flower, crackers, and cement were shipped in them. A barrel of cement, though, weighed 400 pounds, and it was soon found that this was too heavy a weight to be handled economically on construction work. Then the cloth sack, containing 94 pounds net, was adopted, and is still the standard. Attempts have recently been made to substitute paper sacks similar to those used for finishing lime, but they have not been very successful.

The packing of cement is made very difficult by the nature of the material. The particles are almost as sharp as emery, and so fine that they filter into all parts of the machinery. Hence cement equipment is subject to tremendous wear, and delicate parts are soon out of order.

When cement is full of air, it flows almost like water, but when compacted, it will stand with almost vertical faces. This property makes it very easy to handle with screw conveyors, but gives trouble in the storage bins.

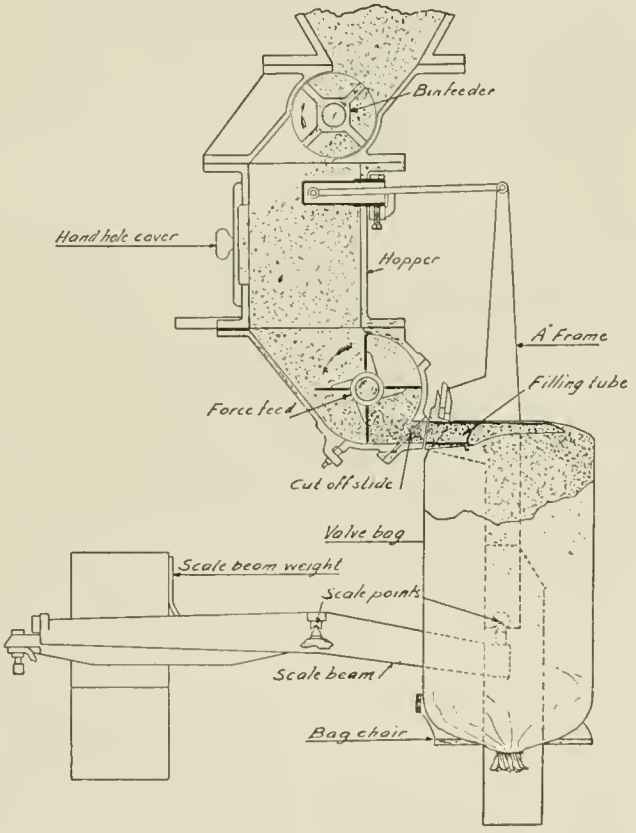
Since the demand varies with the season, the mill must have a large storage capacity for the finished product. The material goes into storage hot from the kilns, and is still warm when it is drawn out for packing. In the late summer, when the stored cement is exhausted, the packers must handle stuff so hot it almost burns their hands.

In one large, modern cement plant with which I am acquainted, large steel silos are used for storage. In front of the storage silos is the packing house, where the cement is sacked. A switch track runs along the open side of the packing house. There are ten packing machines, with a small storage bin over each.

From the storage silos the cement is taken to a screw conveyor which feeds the working bins over the packing machines. Above each bin there is an opening in the bottom of the conveyor trough through which the cement drops, until the bin is full. Then the cement in the bin plugs the hole, and the charge in the conveyor is carried on to the next bin. Any overflow from the last bin is carried down a spout to the bottom of the storage silos, and starts its journey over again.

Seven of the packing machines are of the hand type. They were the first kind installed, and are very simple in construction. A vertical spout of slightly smaller diameter than a cement sack leads down from the working bin. A power auger inside the spout feeds down the cement, and by stopping the auger, the flow of cement is also stopped. A sack is slipped onto the spout, and its bottom rests on a spring suspended table. Then the auger is started and the cement fed into the sacks. When the proper weight is attained, the table drops down and stops the auger. Then the workman ties the sack, and puts it onto his two-wheeled hand truck. Seven sacks are handled at a time, and that is a pretty good load for a strong man.

There are three semi-automatic packing machines in the plant. They operate on an entirely



Cross Section of Cement Packing Machine

different principle from the hand machines. Three or four sacks are filled at once, each is handled individually.

It would be very inconvenient to tie the sacks

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Farewell, Seniors! Best Wishes

June brings a new period in life with its many new responsibilities to the graduating seniors. Just how well a man is fitted for these responsibilities depends greatly on the man, however, every senior may feel that he is pretty well fitted for life when he receives his degree. Other things, such as experience and further education, will add to his fitness as time goes on.

The majority of those graduating will not take graduate work, and it is they whom we caution to provide some means for further education. Perhaps in no field is advance being made more rapidly than in the field of engineering, and unless one keeps in touch with the latest developments in the profession he is certain to soon fall behind and be grouped with those who have not been successful. Such a career is wilful and inexcusable, for there is a sure and certain way to keep in touch with the latest development in the profession; namely, through the engineering societies which embrace every branch of engineering.

There is no better way to keep in touch with the profession than through the publications of the various engineering societies. Each society provides a membership for young engineers and every graduating senior should become a member of the society in his particular field at once. The value and necessity of such a relationship cannot be overemphasized, and we say to every senior:

Join the engineering society in your particular field of engineering.

A Suggestion for the Summer

Probably summer will find most of the engineers engaged in some kind of work relative to their particular branch of engineering, and many will find their work of sufficient interest to write about it and tell others of their experiences. Such interest is to be commended and it is hoped that more and more engineers will take such an attitude toward their work and write concerning it.

To add impetus to the movement, Mr. J. V. Shaefer, '89, has offered an annual prize for the best article on summer work. Next year the prizes will be $25 for the best article,

and $15 for the next best article. The Technograph is anxious to support the movement also and is anxious to publish student articles of merit that come to its attention. We urge every engineer to write an article, for regardless of whether or not it wins a prize or is published, the writer will obtain considerable valuable training in expressing himself and in the use of English.

The Technograph wishes every engineer a happy summer, and hopes that all will come back in the fall with a complete knowledge of the work that they have been on all summer, and determined to write an article about it. The value of the experience will be well worth the effort.

Dr. Nathan Ricker

In the passing of Dr. Nathan Clifford Ricker, Professor Emeritus of Architecture, the University has lost one of its oldest and most eminent alumni, and the profession has lost one of its most brilliant scholars. In the College of Engineering and particularly in the Department of Architecture will his loss be felt for it was there that he was best known and most respected.

Dr. Ricker was an untiring and zealous seeker after knowledge, and his success in broadening the scope of architectural education in America will be remembered as long as architecture is taught at Illinois. In particular will he be remembered by his students and co-workers, who knew him not only as a great scholar but also as a kind and sympathetic friend.

His life will be an inspiration to every student of architecture, his works will be remembered down through the years, and his great contribution to education—the Ricker Library of Architecture—will stamp him forever as a man who lived that he might help his fellow man, and who asked no reward other than that of knowing that his life had been worth while. Such, indeed, is a great man.

The Engineers vs. Campus Traditions

In this day when law breaking, in some forms at least, is looked upon by a great many as a clever, admirable and daring accomplishment, and is becoming the common practise of the same many, it is little wonder that one of our campus traditions—an unwritten law—should come in for its share of flagrant violations. Yet, how decidedly "unclever," "unadmirable" and "undaring" it is to violate a campus tradition.

Unlike the civil law, there is no policeman to enforce a campus tradition; there is no penalty for its violation. Hence there is noone to outwit and no one's eyes "to pull the wool over," so that in no way is there anything admirable in the deed. It reminds one of the person who cautiously looks around to see if he is being observed before cheating in a game of solitaire. We laugh at such a person for he is cheating no one but himself; yet, how little different is his action from that of a student who thinks how brazen and lawless he is because he breaks a rule that he is supposed to enforce when he smokes on the campus.

This semester there has been a continual growth in the number of men who smoke on the campus. Evidently there is little regard for this one distinctive tradition of our campus, and unless student spirit changes at once, the tradition will be but a memory.

The engineers have been as guilty as any others in smoking on the campus, and despite efforts to stop it open violation of the tradition continues. Remember engineers, that as students of the University, the tradition is yours. It is up to each and every engineer to uphold and further it. This can be best done by not smoking on the campus, and by discouraging others from smoking on the campus. Remember, no one admires a man who cheats at solitaire.

COLLEGE NOTES

Final Honors

Twenty-four senior engineers have been awarded Final Honors by the University for excellence in scholastic work. L. J. Bowditch, m.e., was the highest in the college with an average of A in all of the required work in his course. The men receiving Final Honors and their averages are: L. R. Andrew, 4.89; H. U. Arning, 4.70; V. W. Boeker, 4.81; L. J. Bowditch, 5.00; V. F. Buddeke, 4.34; L. A. Burch, 4.70; J. I. Cain, 4.68; G. E. Catlin, 4.60; H. Y. Chang, 4.49; M. K. Fahnstock, 4.83; E. C. Hartmann, 4.79; R. E. Hookham, 4.58; J. T. Jackson, 4.41; Frederick Lindvall, 4.83; F. L. Molohan, 4.56; G. V. Nelson, 4.67; T. E. Ormiston, 4.80; G. G. Robinson, 4.85; J. W. Romig, 4.55; M. W. Rosenstein, 4.79; N. E. Sowers, 4.85; N. A. Tolch, 4.49; H. E. Wessman, 4.94; and C. C. Young, 4.71.

Engineers in Activities

The spring athletics and the annual crop of pledge ribbons have, as usual, found many recruits among the engineers.

When the track team left for the Pacific coast to meet the University of California squad four engineers were on the list. Milt Angier, e.e., '24, and his javelin were there as usual together with Art Rehm, g.e., '25, Johnny Koonz, r.e.e., '25, and Ernie Ponzer, e.e., '25.

L. J. Simmonich, e.e., '25, has been holding down first base on the ball team. G. S. Binger, e.e., '26, C. V. Erickson, e.e., '25, and T. B. Eichler, m.e., '26, are also on the varsity squad.

Several more have found time for some extra work for the Illinois Union. E. R. Morris, e.e., '25, is a member of the Union Cabinet. M. N. Quade, e.e., '25, is chairman of the membership committee for the ensuing year, and Ken Pierce, e.e., '25, is the head of the social committee. The latter is also a member of the Illini Publishing Company's board of control.

Paul Duca, arch., '25, and C. L. Abney, cer.e., '25, have been initiated into Mask and Bauble.

Ted Parker, e.e., '25, was the general manager of the 1924 Electrical Show.

W. L. Edholm, arch.e., '26, and E. B. Brooks, ry.e.e., '24, were in the cast of the "Hottentot."

V. W. Boeker, cer.e., '24, F. L. Michaels, cer.e., '24, and R. F. Fellows, cer.e., '24, have been made associate members of Sigma Xi, honorary scientific fraternity.

K. C. Hu, g.e., '25, S. Hsieh, min.e., '24, and H. Y. Chang, e.e., '24, were initiated into Phi Kappa Epsilon.

F. E. Leib, e.e., '26, A. W. Felt, arch.e., '25, C. E. Clifton, g.e., '25, and K. B. Strong, cer.e., '26 were pledged to Pierrots for their work in the opera.

The University Glee Club had the following engineers among its members: S. B. Hunt, e.e., '25; W. W. Shipley, m.e., '24, D. B. Tuzhorn, m.e., '25; C. H. Wilder, m.e., '27; R. O. Wertz, m.e., '25.

The engineers in the Second Glee Club were: C. C. Anderson, m.e., '21; R. S. Doak, e.e., '27, R. C. Ballard, e.e., '25; W. G. Kennedy, e.e., '25; C. T. Paul, arch., '25; H. L. Funk, e.e., '24; C. M. Peebles, e.e., '27; R. O. Stauss, g.e., '26; H. A. Smith, e.e., '27; and J. B. Ward, e.e., '27.

In the cast of "Carlotta," the student opera, the following engineers had parts: C. O. Anderson, m.e., '24; E. C. Johnson, arch.e., '24; J. C. Sager, m. and s.e., '25; R. O. Stauss, g.e., '25; L. Coughlin, g.e., '25; T. J. Hynds, g.e., '26; W. L. Brazee, ry.e.e., '26; E. E. Blount, e.e., '26; and W. G. Kennedy, e.e., '25.

The following engineers who have had important positions on various campus publications, were initiated into Pi Delta Epsilon, honorary interpublication fraternity, this spring: R. C. Tower, g.e., '25; R. G. Johnson, arch., '25; W. P. Whitney, cer.e., '25; C. E. Parmelee, cer.e., '25; R. J. Gauger, arch., '25; P. G. Dingledy, g.e., '25 and L. R. Ludwig, ry.e.e., '25.

Fraternity Activities

Tau Beta Pi

Tau Beta Pi, honorary engineering fraternity, recently took into membership seventeen junior engineers. The initiation banquet was held at the Inman Hotel, Wednesday evening, April the ninth,

being well attended by the student and faculty members.

Prof. G. A. Goodenough acted as toastmaster. G. G. Robinson, '24, gave the address of welcome and M. N. Quade, '25, responded in behalf of the initiates. The remainder of the program was given by Prof. H. F. Moore, who spoke on the "Broad-Minded Engineer," Prof. W. M. Wilson, who talked on "The Engineer in National Defense," and Prof. L. H. Provine, who choose for his topic, "It Can't Be Done."

The names of the new initiates are as follows: R. O. Askey, c.e., '25; W. S. Clayton, c.e., '25; W. H. Clingman, e.e., '25; P. G. Dingledy, g.e., '25; C. F. Henness, m.e., '25; S. B. Hunt, e.e., '25; R. A. Jaseoviak, e.e., '25; W. G. Kennedy, e.e., '25; A. J. McMaster, g.e.phy., '25; George Mican, m.e., '25; L. A. Mollman, e.e., '25; G. E. Morris, min.e., '25; T. W. Oliver, c.e., '25; M. N. Quade, c.e., '25; B. G. Rich, m.e., '25; I. D. Sklovsky, m.e., '25; and L. Wolinsky, c.e., '25.

THETA TAU

Theta Tau, professional engineering fraternity, has had several interesting programs this spring. At the meeting on Mar. 18, at the Phi Kappa house, H. U. Arning, c.e., '24, gave a talk on Niagra Falls in which he pointed out the beauties of the falls in addition to telling of the power development there. At the Ilus house on April 1, E. C. Hartmann, c.e., '24, told of the Decatur Water Supply Dam at Decatur, Illinois. Hartmann worked on this project for several summers so he was intimately acquainted with the subject. His talk was most interesting, and brought out much discussion from the meeting. The meeting on April 24, was held at the Alpha Sigma Phi house and C. H. Dodge, min.e., '24, told of his summer's experiences while working in the Anaconda copper mines. At the meeting on May 8, a most interesting program was presented by L. J. Simonich, e.e., '24, who told of the experiences of the baseball team on the southern training trip, and by A. C. Rehm, g.e., '25, and E. D. Ponzer, e.e., '26, who told of the experiences of the track team on their recent trip to California for the dual meet with the University of California. The events narrated were most interesting and entertaining.

The spring initiation was held on Sunday afternoon, April 6, at the Sigma Alpha Epsilon house, and was followed in the evening with a banquet at the Urbana-Lincoln Hotel. M. M. McClelland, c.e., '24, was toastmaster, and called on the following members: M. N. Quade, c.e., '25, "Welcome"; J. R. Broderick, e.e., '26 "Response"; R. B. Sargeant, m.e., '24; K. L. Dynes, m.e., '24; Prof. Jamison Vawter, "The Aim of Theta Tau"; and Prof W. M. Wilson, "Oriental Rugs." The following new members were welcomed into the fraternity:

C. D. Anderson, g.e., '26; J. A. Blair, min.e., '25; J. R. Broderick, e.e., '26; M. M. Cooledge, m.e., '25; F. W. Copp, ry.m.e., '25; P. G. Dingledy, g.e., '25; T. B. Eichler, m.e., '26; C. H. Elder, e.e., '25; W. G. Guild, c.e., '25; T. J. Hynds, g.e., '25; W. E. Lynch, e.e., '26; E. P. Mahoney, g.e., '25; A. E. Muerton, m.e., '25; E. R. Morris, c.e., '25; E. D. Ponzer, e.e., '26; B. H. Quackenbush, c.e., '26; E. H. Taze, m.e., '26; M. L. Tucker, e.e., '25; and G. N. Wickhorst, m.e., '25.

SIGMA TAU

Sigma Tau, honorary engineering fraternity has elected it's new officers for the following year: The new officers now leading the chapter are: R. G. Johnson, '25, president; E. R. Troche, '25, vice president; J. E. Inman, recording secretary; W. A. Rolleston, '25, treasurer; C. V. Erickson, corresponding secretary; and T. A. Mollman, '25, historian.

The fraternity also announces the initiation of the following men:

E. V. Johnson, min.e., '25; S. S. Ball, c.e., '25; A. T. Koenen, min.e., '25; C. T. Paul, arch., '25; A. W. Krieg, a.e., '25; J. A. Boyd, a.e., '25; C. C. Anderson, ry.e., '25; B. P. Pond, m.e., '25; R. B. Hall, m.e., '25; B. G. Rich, m.e., '25; L. A. Burch, m.e., '24; S. H. Reid, c.e., '25; W. S. Clayton, c.e., '25; E. Bremer, min.e., '25; J. C. Arntzen, a.e., '25; W. G. Kennedy, e.e., '25; H. L. Hildebrand, e.e., '25; W. V. Woodward, e.e., '25; C. E. Parmelee, cer.e., '25; and H. A. Bartling, e.e., '25.

The initiation was held April 15th at the Inman Hotel and was followed by a banquet. After the banquet Prof. McIntire, Dean M. S. Ketchum and Dr. I. O. Baker spoke.

The Architectural Fete

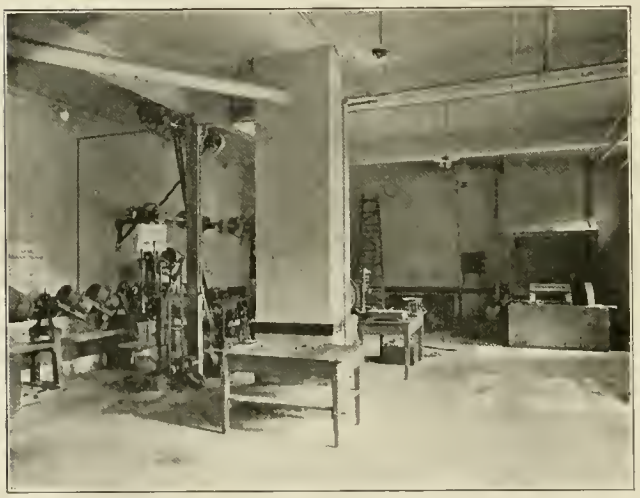
The 7th annual Arch. Fete, the Chinese "Feast of the Welcome to Spring," was held in Ricker Library, March 28th. The corridors were transformed into narrow, crowded Chinese streets, gay with banners and fantasite lanterns in honor of Spring. Through these streets, the prefect (Prof. C. E. Palmer) led his gorgeous procession headed by the sacred buffalo, to the great temple of Buddha, and bade his followers to make merry. Costumes were varied and colorful as the decorations; mandarins and gods dancing with Geisha girls and coolies. The prizes of sets of Mah Jongg, for the best costumes were won by Pearl Nesbit, '24, and Arthur Gallion, arch., '24.

The Improved Highway Laboratories

One of the distinct improvements of which the Civil Engineering Department of the University of Illinois may well be proud, is the development of the Highway Laboratories during the past school year. A complete revision of facilities, coupled with the purchase of additional equipment, has given us one of the best equipped groups of laboratories in the country, for the study of road building materials. 4,900 square feet of floor space is now available for laboratory work; including, classrooms, office and storage space, 8,000 square feet is available. Following is a short description of each laboratory.

Cement and Concrete. The cement and concrete laboratory is now located in the old boiler house, which has been completely refitted. These new quarters have been provided with bins for the storage of cement, standard, ordinary sand, and coarse aggregates. Ample space is available for the student cement tables, and for the molding of concrete specimens. A separate moist room with atomizer sprays for the storage of specimens, a briquette storage tank, and a pat moist closet have been installed in the new space together with the automatic temperature regulator.

All of the equipment for cement and concrete work has been removed from the old quarters in the Highway Laboratory Building. A new Rotap sieve shaker, a 200,000 pound cylinder testing machine, a new motor-driven Jaeger mixer, and additional 2 x 4 and 6 x 12 cylinder molds have also been added.



Interior of Non-Bituminous Laboratory

Non-bituminous. The removal of the concrete equipment from the non-bituminous laboratory has added greatly to the convenience and efficiency of this laboratory. No equipment of any magnitude has been added here.

Elementary bituminous. The room which formerly housed the cement laboratory has now been completely equipped for elementary bituminous work. A chemical desk, equipped with gas, has been moved to this room. The shelf along the west side of the room has also been equipped with gas and is used for special apparatus. On the south side is an electrically equipped shelf, and on the east side, a shelf specially designed for solubility tests of bitumens. It is equipped with vacuum pumps for six independent operations. Several writing tables for care of notes and computations have also been added. These have added materially in the quality of work performed.

Advanced Bituminous. The old bituminous laboratory is being used almost entirely for advanced work or for those tests which demand special apparatus and the use of a gas hood. This room has been equipped with a six-stall gas hood with sliding glass doors, transite partitions, and bottom boards, and a ventilating fan. Some of the additional equipment installed in this laboratory and the elementary laboratory are a Rotarex extractor, a small electric oven, a Saybolt-Furol viscosimeter, and several types of extraction and distillation apparatus.

All of these laboratories will be in readiness for use by the opening of school next fall.

Engineers' Co-operative Society

The following men will constitute the board of directors of the Engineers' Co-operative Society for the ensuing year: D. W. McGlashon, ry.e.e., '25; C. H. Elder, e.e., '25; C. L. Abney, cer.e., '25; I. V. Cohen, ry.e.e., '25; H. N. Hayward, e.e., '24; L. A. Gilman, arch., '25; C. W. Goodman, a.e., '25; T. J. Hynds, g.e., '26; W. D. Kimmel, cer.e., '26; L. H. Bond, ry.e.e., '26; and W. H. McKee, e.e., '26.

The three faculty representatives on the board of directors are: Dean H. H. Jordan, Professor A. R. Knight and Professor W. M. Wilson.

The officers of the board are: President, D. W. McGlashon; Vice-president, C. H. Elder; and Secretary, C. L. Abney.

Phi Eta Sigma Engineers

Sunday, April 13, saw the initiation into Phi Eta Sigma, freshman honorary scholastic fraternity, of eighty-two men, all of whom had averages for their first semester at Illinois of 4.5 or above. Of these eighty-two men, thirty, or over 35 per cent, are Engineers! This, indeed, shows well for our college as leading the other larger colleges of the campus in scholarship. Commerce and L. A. and S. each claimed twenty-three, while the remaining

six were Ag students. These Freshman Engineers may well be proud of the record they have set for their college.

Of the thirty engineers, nine are e.e.'s, eight a.e.'s, seven c.e.'s, five m.e.'s and one r.e. George H. Zenner, m.e., leads the list as the freshman engineer making the highest average, attaining the high standing of 4.94. D. H. Pletta, c.e., ranks second, and Thomas F. McMains, e.e., third. The other engineers in order of standing are: John A. Farwell, a.e.; D. H. Stover, e.e.; John Franks, e.e.; R. A. Niles, c.e.; John W. Ruettinger, a.e.; H. K. Wilson, a.e.; R. J. Solomon, e.e.; C. M. Peebles, e.e.; Otto R. Ariens, e.e.; W. J. Rothfuss, m.e.; F. W. McCoy, e.e.; M. E. Johnson, m.e.; Mark J. Crosset, e.e.; M. E. Grogan, a.e.; W. S. Vrooman, c.e.; L. R. Cook, e.e.; Warren S. Cook, c.e.; Leon S. Harlan, a.e.; K. H. Schnepp, e.e.; J. R. Connelly, m.e.; E. D. McKeague, c.e.; C. C. Baumgardner, m.e.; R. G. Gillespie, a.e.; K. H. Williams, a.e.; George M. Butzow, a.e.; R. A. Preston, r.e.; and O. A. Couter, c.e.

Engineering Experiment Station

The most recent issue of the Experiment Station is Bulletin No. 139, "An Investigation of the Maximum Temperatures and Pressures Attainable in the Combustion of Gaseous and Liquid Fuels," by G. A. Goodenough, Professor of Thermodynamics of the University, and G. T. Felbeck, research assistant. It is dated March, 1924. Certain chemical reactions which are associated with high temperatures posses great technical importance. Among these are the combustion reactions such as occur in boiler practice, in the internal combustion engine, in the gas producer, and in the oxy-hydrogen flame. Reactions at high temperatures present certain phenomenon which have not heretofore received the attention they deserve from engineers. The reaction energy or available work of the reaction is not generally the exact equivalent of the heat reaction. Also, at high temperatures, a reaction cannot proceed to completion but halts when the constituents attain a state of equilibrium. So the problem investigated was "first, to investigate the conditions of equilibrium and establish the necessary equilibrium equations; and second, to incorporate these into a formulation by means of which the maximum temperature resulting from the combustion of a fuel under predetermined conditions may be calculated."

A brief résumé of the important laws of gas mixtures is given in Chapter II, while Chapter III gives the general theory of chemical equilibrium and the derivation of equilibrium equations. Chapter IV develops the energy equation and the method of solving the system of equations for maximum temperature is shown. The remaining chapters are devoted to comparisons and application of the theory.

Other bulletins being prepared and to be issued soon are: "The Viscosities and Tensions of Glasses at High Temperatures," by Washburn, Chilton, and Libman, to be out in about a month. "Investigation of Warm Air Furnaces and Heating Systems, Part II," by A. C. Willard, A. P. Kratz, and V. S. Day; and "Investigations of Fatigue of Metals, Series of 1923," by H. F. Moore and T. M. Jasper, will be published sometime this summer.

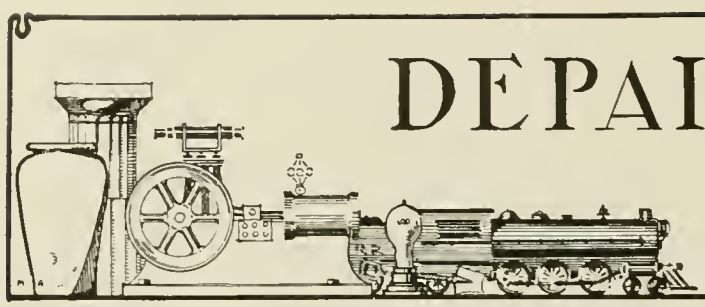
New Experiment Station Bulletin

The fourth of a series of warm-air furnace research bulletins by the University Engineering Experiment Station is just out, being dated May 12, 1924. The complete title is: "Investigation of Warm-Air Furnaces and Heating Systems, Part II," by A. C. Willard, professor of heating and ventilation; A. P. Kratz, research professor; and V. S. Day, research assistant professor. It is published under a co-opertaive agreement between the National Warm-Air Heating and Ventilating Association and the University of Illinois, for an investigation of warm-air furnaces and furnace heating systems. The agreement was approved in August, 1918, and the research work begun that year has continued since. The results of this research have been given in this bulletin together with three former bulletins of the Experiment Station on the subject, numbers 112, 117 and 120. The present bulletin deals principally with the work accomplished since March, 1921.

The objects of the investigation were, first, to determine the efficiency and capacity of commercial warm-air furnaces under conditions similar to those existing in actual installations. Second, to determine satisfactory and simple methods for rating furnaces so that the proper size and type of furnace can be definitely selected for the service required. Third, to determine methods to increase the efficiency. Fourth, to determine the heat losses in furnace heating systems. Fifth to determine the proper sizes and proportions of leaders, stacks and registers. Sixth, to determine the friction losses, and the proper size, proportion, and arrangement of the ducts and registers. And seventh, to make a study of outside and inside air circulation as affecting the economy and operation of furnace systems.

Two testing plants were used in securing the data and results presented, and were known as the Piped Furnace Plant and the Auxiliary Plant. The former plant was used for securing data on furnace performance, capacity, and efficiency under varied conditions, while the latter plant was used for studying the characteristics of stacks, leaders,

(Continued on Page 212)



DEPARTMENTAL NOTES

Architectural Notes

Department Notes

The department is at the present time preparing an exhibit to be sent to the convention of the International Association of Architectural Schools to be held in London during July. The University of Illinois will be allowed two-hundred square feet of space at this exhibit.

The Plym Prize, representing fifty dollars worth of books, was awarded to R. Johnson, H. Peterson, and A. Krieg. Their solutions for 'A Lighthouse," were judged as the three best.

The Van Dort Prize of twenty-five dollars worth of books was awarded to E. H. Mittelbusher and E. I. Harrison. This prize is awarded to the best solutions for the last senior design problem, "A Community Market."

The judgment in New York on the sophomore design problem, "A Frontispiece," resulted in Klappenberg, Thomas, and Gregg receiving first mention and the rest of the class second mention.

In the Junior class, C. T. Paul and K. Reeve received first mentions on their solutions for "A Publishing House," Paul's solution being published in the last "American Architect."

The Plym Traveling Fellowship in Architecture for 1924 was won by J. D. Tuttle '23, of Los Angeles, California. Mr. Tuttle will spend the following year in travel and study in Europe, through the generosity of Mr. J. Plym, a graduate of this school, of Niles, Michigan.

The American Institute of Architects Medal for 1924 was awarded to E. H. Mittelbusher. This medal is awarded annually to the graduating senior who has shown the most consistent development throughout the four years of the course in Architecture. The medal is given in a number of different schools throughout the country and some of the work of each is sent to the Institute headquarters at Washington, D. C. From this work, one man is to be chosen for a travelling scholarship in Europe.

The Scarab Medal, offered annually by Scarab, professional architectural fraternity, for a class problem competition open to Sophomores and Juniors in the courses in Architecture, was won this year by W. A. Rolleston, '25. J. W. Gregg, '26, placed second. The subject of the competition was 'A Funeral Urn."

Scarab

Scarab fraternity held a meeting on April 10, at which the officers for the coming year were elected. The following men were chosen to guide the fraternity during the coming year: A. Gilman, president; R. Johnson, vice-president; E. Taubert, treasurer; and H. Peterson, secretary.

Ceramic Notes

American Ceramic Society

The Student Branch of the American Ceramic Society had quite an active period previous to the construction of the float for Engineer's Day. The financial and working support of the members was very gratifying, considering the size of the Society. The Ceramic Society has an active membership of about forty.

One important reason for a large increase in the attendance at meetings this semester has been the compulsory attendance of the freshmen. Professor Parmelee was unable to arrange an engineering lecture period for the freshmen ceramists, so they have been required to attend the Society meetings.

The last three meetings of the Society have been primarily educational.

On March 27th, a very interesting set of slides were shown on "ball mills" and other grinding machinery.

On April 10 a reel was shown on refractories, entitled "The Story of Fire Clay."

G. B. Tuthill, '24, obtained a very interesting reel which he presented April 24, showing a new method for the mechanical handling of common brick. The bricks are transported entirely from brick machine to motor trucks by means of an overhead crane system. Tuthill is vitally interested in the common brick industry through parental relations.

Department Notes

W. H. Pfeiffer, '24, has just about completed the design of a unique, continuous multi-tunnel dryer for heavy clay products in the senior plant design course.

An exceptionally good collection of pottery, made by ceramic students this year, is still on display in the Engineering Library.

Civil Notes

Department Notes

The Civil Engineering Department proposes to offer a new option in Hydraulic Engineering, beginning next year. Although not definitely authorized as yet, it will in all probability be approved in the near future.

The chief features of this option will be hydrology, drainage, and water power engineering. Recent developments in power development, point to a large demand in the future for men who are especially fitted along the lines enumerated above.

Apparently, there are a large number of positions open this year for civil engineering graduates. There are on file now jobs for twice the number graduating. Highway work predominates in demand, with structural drafting coming second. There will also be some work in hydraulic power development. To date, there have been very few requests from the railroads.

G. V. Nelson, E. C. Hartman, and H. E. Wessman, seniors in this year's class, have signified their intentions of returning next year for graduate study.

L. E. Grinter, who is now taking graduate work, has been awarded a fellowship for second year graduate work, for next year.

Prof. T. D. Mylrea and Mr. C. B. Schmeltzer have completed their investigation on the Mackinaw Bridge on the Big Four Railroad. This bridge is an old iron bridge, built in 1892. The Big Four wanted to know whether or not it could sustain heavier loading than the one for which it was designed. Impact data was compiled and also observations were made so that actual and computed stresses in bridge members could be compared.

Prof. C. C. Williams has just completed a revision of his book, "Design of Railroad Location." The first edition was published in 1917 by John Wiley & Sons, Publishers. The new edition will be out next month.

Am. Soc. C. E.

The Am. Soc. C. E. has had a number of interesting meetings since the last issue of the Technograph. On February 27th, Jacob L. Crane, Member, Am. Soc. C. E., and Consulting Engineer, Chicago, Ill., came down and gave an interesting talk on "City Planning." He carried us back several ages and traced the development of cities down to the present age, pointing out examples of good and bad community plans. The elements governing city planning, or rather city replanning, are safety, beauty, convenience, and economy. Mr. Crane outlined the work now being carried out by the City Plan Commission of Chicago where millions of dollars are being spent, especially in the loop district, to improve traffic arteries leading out of the loop. Mr. Crane's talk was accompanied with slides illustrating the points he brought to our attention.

On March 12th, a joint meeting was held with the Railway Club. The occasion was a movie entertainment, depicting the remarkable development of the "Victorian Railways" in Australia. That part of the films showing the electrification of the roads in Melbourne and through the adjacent suburban districts was especially interesting. It is interesting to note that Chicago is looking to Melbourne as the model for its proposed terminal electrification.

On March 26th, Prof. Hardy Cross, Professor of Structural Engineering, gave an illustrated lecture on "Some Dam Sites and Water-Powers." He stated that there are three factors needed in hydro-electric work, a market for power, water, and a hill for the water to run down. The difficulty lies in finding the three together. Professor Cross also outlined some of the work being carried out by the Northern States Power Development Company in Minnesota and Wisconsin, and dwelt especially upon the St. Croix River Development upon which he was engaged last summer.

Mr. T. C. Hatton, Mem. Am. Soc. C. E., and Chief Engineer for the Milwaukee Sewage Commission, appeared before a large gathering and gave an illustrated lecture on "The Construction of the Sewage Treatment Plant in Milwaukee." The activated sludge plant now in process of construction on Jones Island is the largest one of its type in the world. The unusually interesting mechanical and electrical features which are a part of this plant make it of exceeding interest to several branches of the engineering profession.

On May 7th, Prof. C. C. Williams, Head of the Civil Engineering Department, spoke on "Modern Methods of Construction."

The Am. Soc. C. E. is planning an inspection trip for this spring. President Herting has appointed S. R. Alberts, '24, as chairman of the Committee on Arrangements. In all probability, the objective will be Danville or its vicinity this year.

Electrical Engineering News

E. E. Society

Most of the meetings of the E. E. Society held during the semester were concerned with the E. E. Show and the establishment of a student loan fund.

The Society has quite a sum of money in the treasury which has been accumulated in the past few years from the proceeds of the biennial shows and it is with this that the Society intends to establish the fund. A questionnaire was distributed among the juniors and seniors in the college, to determine to some extent how much money could be put into use for loans among the electrical engineering students. It was found through the questionnaire that a great many of the electrical engineers in the upper classes would avail themselves to the use of such a fund. The information obtained is to be used in working out the final plans for the fund with the committee of the faculty which has jurisdiction on such matters.

Eta Kappa Nu

Eta Kappa Nu held its semi-annual initiation and banquet at the Inman Hotel on Thursday evening, March 27th. One senior, seven juniors and two faculty men were initiated. Prof. E. B. Paine spoke at the banquet on "Outside Activities." Prof. A. R. Knight acted as toastmaster.

H. A. Keener and C. A. Brown, of the Electrical engineering faculty, E. K. Shively, '24, H. L. Hildenbrand, '25, J. C. Koonz, '25, M. S. Luthringer, '25, Clyde Rettenmayer, '25, H. E. Weaver,, '25, C. D. Wheeler, '25, and W. V. Woodward, '25, were initiated.

E. E. Show

The Electrical Show held at the E. E. Lab and the Gym Annex on April 24, 25, and 26 was a decided success in every way, even though there was a heavy rain during two of the four shows. The stunts were superior to those of previous shows and were almost all in operation on the first night of the show. There were many new stunts and quite a few new exhibits by commercial firms.

Among the most important student stunts were the Model Miniature Railway, Radio Controlled Automobile and the Tesla coil. The everflowing wine bottle was also quite an attraction.

The miniature railway was operated and controlled electrically. The remarkable ease of operation and control was a tribute to the engineering ability of the men who engineered the stunt.

The Telephone exhibit, the Printing Telegraph and the movies of "The Story of Coal to Power" attracted many. All of the commercial exhibits were well selected as to their entertaining and educational possibilities.

The board of managers is to be congratulated for the success of the show. Work was started on the actual plans early in the first semester and under the guidance of the managers everything was in shape for the show to begin on time and excel anything ever attempted before.

Mining Department News

Faculty

The research work being carried on by Prof. Thomas Fraser and L. A. Moses, graduate student in mining engineering, progresses rapidly. Their time is spent at mines throughout the state and in theoretical work in the mining laboratory. A bulletin will be published covering their experiments and tests in mine ventilation.

Mining Society

The Mining Smoker held in the Union Building, February 27, was undoubtedly the best yet attained by the society. In a short business meeting which preceeded the festivities R. A. Podesta gave an encouraging report for the membership committee, H. E. Butters reported on the finances of the society, and President Lubelsky voiced his appreciation of the large turnout of members.

Prof. Hoskin, was present and gave an interesting and humorous talk on some of his mining experiences and past events of the society. E. C. Johnson gave a report on the progress of the memorial to Professor Stoek. It was decided to accept subscriptions from the numerous associates and friends of Professor Stoek and thus make it a representative memorial.

Mr. L. D. Tracy, superintendent of the U. S. Bureau of Mines Station at Urbana, spoke on mine disasters and their prevention. Jerry Cope obliged with several numbers on his famous banjo which were heartily received. Prof. Drucker told of Engineers' Day and the part the mining department played, and of the Engineering Convocation. Prof. Bains gave a very interesting talk on one of his experiences in the Spanish-American War.

The remainder of the program was both entertaining and instructive. H. C. Wai, Ving Po, China, rendered a few selections on his chinese violin. T. Banno next obliged with his college song "Waseda." A. G. Cadaval, Durango, Mexico, gave some of his ideas of Mexico, after which B. L. Kashin explained certain interesting facts about Siberia. L. A. Moses, Johannesburg, South Africa, rendered a couple of blood-curdling yells presumably used by the South African cannibal head-hunters just before their dinners. Cider, doughnuts, apples, and cigarettes helped to spread the jollification and left that desired effect of "well entertained."

A meeting of the Mining Society was held Wednesday evening, April 9, to witness the showing

of the slow-motion pictures of rock crushing in rolls and ball mills. These pictures were loaned the department by the American Institute of Mining and Metallurgical Engineers for the third showing in the United States.

The annual mining society banquet was held Sunday evening, May 11, at the Urbana-Lincoln hotel. Professor J. W. Garner, professor of political science, gave the address of the evening. Professor Garner spoke on the International Political Situation of the present and future. L. A. Moses gave his impressions of the American University. E. C. Johnson told of the past history of the society and N. A. Tolch of what its future efforts should be. Professor Hoskin gave the Seniors a real "bonne voyage" in his message of cheer to those who are soon to "step off."

Delta Mu Epsilon

Delta Mu Epsilon, honorary mining engineering fraternity held their informal initiation April 27 when they conducted the following pledges: L. A. Moses, gradnate student, E. Bremer, '25, A. E. Murton, '25, and A. T. Koenen, '25, into one of the coal mines near Danville. The pledges were put through practical mining tests and competitive events such as drilling, blasting, and loading.

Formal initiation and banquet were held at the Inman hotel, May 4, at which time Professor T. M. Bains and Mr. C. M. Smith, instructors in the department, were made honorary members. Professor Hoskin, as toastmaster, kept up a running fire of jokes and stories and succeeded in drawing out a number of interesting mining tales from those present. N. A. Tolch, president, gave out the "muck" on the new members. Professor Drucker spoke of the first three years as a mining engineer. G. I. Smith gave the charge to the new members.

Department Notes

A special meeting of the mining department was held March 12 to hear Mr. H. F. Bain, director of the U. S. Bureau of Mines, who was visiting the University with Dr. Wheeler, director of the department of mines of England and engaged in research in England similar to that undertaken by the United States. Mr. Bain spoke on his experiences in Chili on a tour of inspection last year. There he studied human relationships and the personal efficiency of the native miners. Mr. G. R. Rice, chief engineer of the U. S. Bureau of Mines told of the research conducted by the bureau in regard to mine explosions. Dr. Wheeler was introduced but, the time being limited, could only invite those present to a lecture to be given by himself that evening before the American Society of Chemists and guests.

Professor A. J. Hoskin, Professor T. Fraser, C. H. Dodge, B. L. Lubelsky, R. L. Fleming, B. C. McCown, and D. B. Buchanan attended the annual convention of the National Coal Operators Association at Cincinnatti, May 13 to 19.

Railway News

Railway Club

At the first meeting of the Railway Club, in April, final plans were made and work was assigned on the Railway Float which appeared in the parade on Engineer's Day. L. R. Ludwig, '25, was elected to succeed R. A. Preston, '27, as secretary-treasurer of the club. Mr. Preston was forced to withdraw due to ill health. After the regular and special business, the boys enjoyed a well earned feast and smoker.

At the second meeting of the month, Mr. C. C. Herrmann of the Department of Economics, gave an interesting talk on 'The Future of Railway Legislation."

The first meeting in May was featured as a "get-together" meeting. Impromptu talks were given by various members of the Club.

Department Notes

The seniors of the department made a test run to Mattoon and return in the dynomometer test car, owned jointly by the University and the Illinois Central Railroad. The freshman railway engineers have also made the test trip in order to get an idea of how the car works. The department expects to make three or more test trips before the end of the semester.

Prof. J. M. Snodgrass recently made some road tests on the Chicago, Milwaukee and St. Paul Railroad. The purpose of the tests were to compare the operation of locomotives with and without feed-water heaters.

Prof. J. K. Tuthill has completed the drop tests made upon various kinds of rail joints, now used extensively and has sent the fractured samples to the Bureau of Standards at Washington, D. C., for microscopic examination.

The mechanical department recently made a comparative test of three types of brake shoes for the Illinois Central Railroad.

Sigma Epsilon

Sigma Epsilon, the honorary railway engineering fraternity, which was organized at the beginning of the year, initiated two men, L. R. Ludwig, '25, and W. L. Brazee, '25. John Koonz, '25, was recently pledged. An initiation banquet was given at the Southern Tea Rooms the first Sunday in May.

The Standard Handbook, offered by the fraternity for the best idea for the Department Float, was awarded to E. J. Gardey, r.e.e., '24. Mr. Gardey's idea made a very good and effective float.

THE ROOTERS

"Yes, I have two boys in college."

"What is their yell"

"Money, money, money."

—*Louisville Courier-Journal.*

His wife: "What's more, I saw you with your Board of Directors . . . and I think the hat she had on was something awful."—*Sans-Gene (Paris).*

USE YOUR OWN TUNE

Lives of chorus girls remind us,
As their pages o'er we turn,
That we shouldn't leave behind us,
Money for our sons to burn.

Bob (inspecting car Harry's dad just purchased): "Some lil' cart How fast'll she pick up?"

Harry: "Oh, on a good night she oughta pick up a couple every ten minutes."

HER NAME, PLEASE

Her husband had just come home and had his first meeting with the new nurse who was remarkably pretty.

"She is sensible and scientific too," urged the fond mother, "and says that she will allow no one to kiss baby while she is near."

"No one would want to," replied the husband, and then the fur flew.

CRASH

He had married a widow and all went well for a week, when they had their first quarrel. The next day he came down to breakfast with a mourning band on his arm.

"Oh, I'm sorry," said his wife. "What is it for?"

"For your first husband," he replied, "I'm sorry he died." —*Exchange.*

A CLOSE BUYER

"I vish I vas as religious as Sammy."

"For vy?"

"He clasps his hands so tight in prayer, he can't get them open ven the collection box comes aroundt."

GETTING EVEN

"Hey, Bill, your doctor's out here with a flat tire. He wants to know what it's going to cost him," announced the garage owner's assistant.

"Diagnose the case as flatulency of the perimeter, and charge him $5.00," came the answer.

OF COURSE

"Hey!" yelled the policeman, "you can't park there."

"Why can't I?" exclaimed the bewildered motorist. "The sign says 'Fine for Parking'."

REASONABLE DOUBT

One afternoon a stranger, after debarking from a train in a hustling western town, headed up the street. Finally he met a man who looked like a native.

"Pardon me," said the new arrival, "are you a resident of this town?"

"Yes sir," was the ready answer. "Been here something like fifty years. What can I do for you?"

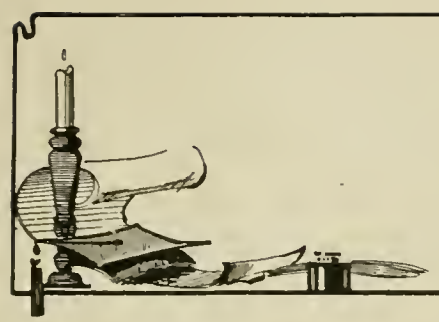
"I am looking for a criminal lawyer," responded the stranger. "Have you one here?"

"Well," said the native, reflectively, "we think we have, but we can't prove it on him."

SUIT YOURSELF

Wrecked motorist (phoning): "Send assistance at once. I've turned turtle."

Voice (from the other end of the wire): "My dear sir, this is a garage. What you want is an aquarium."



ALUMNI NOTES

Henry Penn, c.e., '10, is now assistant professor of civil engineering and baseball coach at Armour Institute, Chicago.

Lester Seelig, m.e., '22, is now an engineer for the Drying Systems, inc., of Chicago.

W. H. Rodgers, e.e., '22, is with the Westinghouse company at East Pittsburgh working on transmission line and central station problems.

R. E. Lindsey, a.e., '20, since last fall has been graduate assistant at Iowa State College in architectural engineering. His research is on rural structures.

George C. Seibert, a.e., '20, is architectural draftsman for the Edward Benson and Son, architects, at Chicago.

Elmer G. Staley, m.e., '21, is employed in the refrigeration department of the Henry W. Vogt, machine company, of Louisville, Ky.

A. M. Grass, m.e., '21, of the Goodman Mfg. Company, Chicago, is engaged in the development of a coal loader for mines.

Allen Barry Campbell, e.e., '09, is employed with the National Electric Light Association of New York.

Paul Crowell, e.e., '10, is now chief engineer for the Armour Fertilizer Works, Chicago.

Ferdinand Jehle, m.e., '10, has been made research engineer for the White Motor Company, Cleveland. He was formerly with Aluminum Manufacturers, inc.

L. Kummer, ry.e.e., '10, has been at Pilgrims Rest, Transvaal, South Africa for over a year as resident engineer of the Transvaal Gold Mining Company.

Eugene S. Pennebaker, e.e., '10, is corporate chief engineer of the Texas and Pacific Railway, Dallas.

E. S. Hight, e.e., '10, has been promoted to general operating engineer for the Illinois Light and Power Corporation, with general offices at Chicago. He is now finishing the construction of the Topeka, Kansas, power house and transmission line.

Harris E. Vandevcer, e.e., '12, died November 26 at his home in Springfield. He was born in Edinburg, Illinois, January 21, 1890, and attended the Edinburg high school. While at the University he was a student in electrical engineering, a member of the band, and of Chi Phi. He was a second lieutenant in aviation during the world war. He is survived by his wife and two year old daughter.

John G. Sponsel, m.e., '11, has been since 1913 in Gary, Indiana, with the American Bridge Company. For the last eight years he has served as master mechanic and electrical engineer.

C. E. Henderson, e.e., '06, has left engineering for insurance. He is located at Windsor, Ont.

V. A. Roland, a.e., '14, Champaign contractor, has for the last few years been interested in apartment house buildings. He recently completed a 24-apartment building and has already started on a similar one.

Paul Conklin, m.e., '17, teaches cabinet making at the Rockford high school.

C. C. Clegg, m.e., '18, manages the Kansas City office of the American Blower Co.

H. B. Utter, m.e., ('17), is property engineer in the boiler plant and boiler plant equipment of the Detroit Edison Company.

Phil T. Dedman, m.e., '22, is engineer for the Kansas City Utility Company, located at Fort Scott, Kansas.

Edward Stachel, e.e., '23, is with the Chicago Elevated Railway Co.

M. E. Capouch, min.e., '23, is with the Rock Island Railway at Chicago.

Paul Vance, e.e., '23, and *J. H. Stark*, e.e., '23, are employed at Fort Wayne, Indiana, with the General Electric Company. *R. T. Routh*, e.e., '23, is in Cleveland with the same company.

Paul F. Witte, m.e., '23, is engineering salesman for the Henry Vogt Machinery Company, Louisville, Ky.

C. G. Rosaire, e.e., '23, is construction foreman on the stadium.

E. L. Young, e.e., '23, and *Sidney Wirth*, e.e., '23, are with the Western Electric Company at Chicago.

Frank F. Stamberg, min.e., '21, is editor and compiler of the Engineer's Handbook of the Goodman Mfg. Co., Chicago.

C. H. Mottiers, c.e., '10, is office engineer for the Illinois Central R. R. and is in charge of the new terminal design at Chicago. He received his professional degree of Civil Engineer in June.

R. F. Fagerburg, min.e., '23, is coal mine inspector for the Orient Coal Mines at Herrin, Illinois.

E. F. Bruhn, c.e., '23, is instructor of Civil Engineering at the Colorado School of Mines.

Wallace Waterfall, e.ph., '23, the first graduate of the Engineering Physics Department, is with Griffith and Goodrich, architects, of Fort Wayne, Indiana. His work is in structural and heating design.

Harold Barden, e.e., '15, is with the Southern California Edison Co., at Los Angles. He has recently been made editor of a publication of that company.

D. W. Johnson, e.e., '23, is with the Central Illinois Public Service Co.

J. H. Setinsky, min.e., '23, is at the Mayo Brothers Sanitarium at Rochester, Minn., where he has just undergone a major operation.

William H. Murch, cer.e., (26), is with the Murch Bros. Construction Co., at Little Rock, Arkansas, engaged in the erection of eight government buildings.

M. A. Matsuno, ry.e.e., '23, has just completed the work for his Master of Science degree. He is going east to study our American railroads, and then on to Europe to study the railways conditions there. He has a position on the South Manchurian R. R. in Japan.

Charles T. Ripley, ry.e.e., '09, is now chief mechanical engineer of the A. T. & S. F. at Chicago.

H. M. Moss, m.e., and *G. J. Boshkoff*, m.e., '23 apply their Thermodynamics to problems which arise in their work with the Linde Air Products Co., at Buffalo, N. Y.

E. M. Kerrigan, m.e., '23, is with the construction department of the Westerlin and Campbell Co., Refrigeration Engineers, Chicago.

Maurice Olchoff, m.e., '23, is with the Natkin Engineering Co., Commercial Engineers, Kansas City, Mo.

R. E. Gould, m.e., '23, is with the Engineering Department of the Car Dumper and Equipment Co., Chicago.

John R. Green, cer.e., '23, visited the University for a few days recently. He has been selling for the North Iowa Brick and Tile Co., of Mason City, Iowa.

B. B. Shaw, ry.e.e., '11, is chief engineer of the Cuba Central R. R. and is located at Camagney, Cuba.

Fred B. Metterhausen, ry.e.e., '21, is with the Cuba Central R. R.

A. C. Hobble, e.e., '01, is chief engineer for the largest hydro-electric plant in Spain. He returned to the United States last fall on leave of absence. He may visit the University.

G. P. Fenn, m.e., '23, is with The Buda Co., New York City.

A. B. Stevens, min.e., '23, is first assistant assayer for the Inspiration Copper Co., in Arizona.

Robert S. Sanford, min.e., '23, is chief assayer and mining engineer for the Columbian Exploration Co., Columbia, S. A.

E. F. Carpenter, min.e., '23, is first assistant assayer for the Tomboy Gold Mining Co., of Colorado. *Harry Jessing*, min.e., '23, is chief assayer for the same company.

D. O. Whelan, e.e., '23, is now with the General Electric Co., at Schenectady, N. Y. He is engaged in research and radio development.

Sourn Rupa Bahkshi, ry.e.e., '15, is in the Maintenance of Way Department of the Burlington at Lincoln, Nebraska.

E. A. Williford, e.e., '16, is now assistant sales manager for the carbon products division of the National Carbon Co., at Cleveland, Ohio. Williford, besides being the star basketball player of the conference, was head of his class in scholastic standing.

R. H. Hornback, e.e., '22, was forced to give up his work with the General Electric Co., because of his poor health. He has now recovered and has accepted a position with the North American Light and Power Co., Chicago. He is doing valnation work.

V. T. Koo, e.e., '14, is dean of the department of engineering at Nanyang University, Shanghai, China.

W. A. Mann, e.e., '23, is now with the General Electric Co., at Schenectady. He will be at the University as a scout for that company the latter part of February.

Robert U. Nichols, a.e., '23, is working in the architectural department of the Southern California Edison Co., Los Angeles. He writes that *C. B. Carlson*, a.e., '09, is assistant chief structural engineer, and *John Strom*, c.e., '10, is chief draftsman.

R. C. Hermann, e.e., '15, is manager of the transportation of the Detroit branch of the Westinghouse Electric Co.

Don Monti, e.e., ('24), who was obliged to withdraw from the University because of his poor health, is now at his home at West Frankfort, Illinois.

W. H. Rodgers, e.e., '22, is associated with the General Engineering Department of the Westinghouse Electric and Mfg. Co., at East Pittsburgh, Pa. Mr. Rodgers devotes his attention to transmission line and central station problems.

D. N. Ellett, a.e., '23, is helping build the vehicular tunnel between New York City and Jersey City.

O. S. Mundy, cer.e., '23, is with the Uhle Pottery Company, Huntingburgh, Indiana.

J. R. Lindley, e.e., '21, is now sales manager for the C. F. Pease Co., Chicago. He has the northwest territory, consisting of Minnesota, and North and South Dakota. Last year Lindley was manager of the Engineer's Co-op.

Frank J. Naprstek, a.e., '14, is engineer for the Pheoll Mfg. Co., Oak Park.

Horatio M. Fitch, e.e., '23, is instrument man with the Chicago Union Station Co., Elmhurst.

Geneva Fleming, arch., '23, is architect for Graham, Anderson, Probst and White, Chicago.

Harlow Amsbary, m.e., '14, has now gone into business for himself as builder. He had been superintendent for a large construction company in Detroit.

Charles Warinner, m.e., '14, has been sent to London on business for his firm, the Illinois Stoker Co., of Alton.

Frank T. Sheets, m. and s.e., '14, as state superintendent of public highways, has had under his direction the immense road improvement program of Illinois. Last year 1077 miles were completed.

Cecil W. Smith, min.e., '13, chief engineer of the Nason Coal Co., visited the campus recently to address the seniors on "The Marketing of Bituminous."

Hugo Layer, a.e., '11, representing the E. W. Sproul Construction Company, visited the campus recently to look over the plans of the proposed new buildings.

Leon F. Urbain, arch., '10, who opened an architectural office in Paris immediately after his military service, has been on a brief business trip to the United States.

Charles Cross, arch., '92, is chief engineer for the Mississippi Valley Structural Steel Co., St. Louis.

Edward S. Johnson, e.e., '87, is president of a locomotive works at Davenport, Iowa.

T. I. Fullenwider, e.e., '02, is assistant engineer of construction, division of highways, and is located at Springfield.

H. W. Dietert, m.e., '22, who received his Masters Degree here last June, is employed with the United States Radiator Corporation, Detroit, as engineer in the production department.

James W. Ballard, e.e., ('25), teaches physics and math in the high school at Industry, Ill.

Cement Packing

(Continued from Page 193)

after they are filled, so they are tied before filling. One of the bottom corners of the sack is slit open for a short distance, and turned inside to form a combined tube and valve. After the sack is filled the pressure of the cement causes the tube to collapse, and so closes the opening.

The essential parts of the packing machine are a rapidly revolving impellor or fan, and the filling tube through which the cement passes into the sack. The valve of the sack is slipped over the end of the tube, and a gate valve in the tube opened, starting the flow of cement. At 94 pounds the weight of the sack closes the gate valve, and the operator pulls a lever which strips the filled sack off the nozzel, and allows it to slide down a short incline to a delivery table. Truckers then handle it into the cars just as from the hand operated machines.

In this particular cement mill, the foreman operates the packing house on a contract. He receives a certain amount per sack from the company, and pays all his own labor. The men are all on a piece work basis, and it is reasonable to suppose that the work is done as economically as possible.

At first glance, it would seem poor management to operate hand and automatic machines at the same time, but it is done here. There are several good reasons. First, the packing house works at full capacity during only a few months in the year, and so it is desirable to keep the machinery investment as low as possible. Then, the automatic machine forces the cement into the sack under considerable pressure, and it will spurt out through any little tear in the cloth. The valves often become caked shut, and cause considerable trouble. But, because its capacity per man-hour is considerably less than that of the automatic machine, the hand machine is rapidly being forced out.

The automatic machines are built with either three or four filling tubes. Using four tubes, they require two operators, a belt conveyor from the machine to the car, and three men trucking in the car. The capacity is about 188 sacks per man-hour. Using only three valves, the crew consists of one operator, two truckers, and *no* conveyor. The capacity here is 220 sacks per man-hour, or 6,600 sacks in a ten hour day.

Ten cars of cement a day, coming from three little tubes!

HIRE A HALL

Patient: "Is my mouth open wide enough, dentist?"

Dentist: "Oh yes, ma'am. I shall stand outside while drawing the tooth."

Coal Dust Hazards

(Continued from Page 186)

come partly closed by small particles of coal coking and adhering to the burner.

The back pressure thus created would tend to draw the heat from the furnace into the feed line, igniting the pulverized coal, and the fire would quickly spread to the distribution line. It may happen, if the primary air is shut off, that there will not be enough oxygen in the line to support combustion until after the air current becomes normal when the smouldering coal may be fanned into a flame.

It is of extreme importance that no opportunity be given burning particles to get into the transport line, either from the storage bin or by "back fire" from the furnace. Frequent inspection should be made of the burners and any coked particles thereon should be immediately removed.

As often as practicable, when the plant closes down at night, all furnaces should be cut off the supply line, the gate from the pulverized fuel bin closed and the transport line thoroughly cleaned by allowing the fan to force a current of air through it until all the pulverized coal is blown out.

Where furnaces are equipped with individual fuel bins and the coal is delivered into the primary air line by means of screw-conveyors, the fuel bins should be placed away from the furnaces. Several fatal accidents have been caused by dust overflowing the line, falling down in front of the furnace door, igniting and flashing up and enveloping the furnace operator in flames. It is true that bins may be fitted with automatic gages and also completely covered, but even with these precautions, dust clouds may be formed. Some of the steel companies in whose plants accidents from overflowing bins have occurred have placed every pulverized coal bin in the rear of the furnace and just outside the main building. By doing this all danger of a dust cloud coming in contact with hot metal or flames in the furnace, is reduced to a minimum.

In nearly every coal pulverizing plant, there is more or less fine coal dust deposited on the floor, the pulverizing machinery, girders and window sills of the building. If, for any reason, this dust should be raised into a cloud and then come in contact with an open flame, it is probable that an explosion would occur which would wreck the plant. In fact, there was an actual occurence of this nature in a coal pulverizing plant in which a primary explosion happened in the pulverizer and raised the dust in the building into a cloud, ignited it, and the resulting explosion caused considerable damage to the building, as well as costing loss of life.

Every effort should be made to prevent any accumulaton of dust in the building that houses the pulverizing apparatus. Certain manufacturing plants in which explosive dust is prevalent have installed vacuum cleaners to keep the buildings free from dangerous quantities of explosive dust, and such systems have been in use for many years in Northern France and Germany in connection with coal screening plants. This would not be impracticable in a coal pulverizing plant. The recovered dust could be delivered to the pulverized coal bin and used in the furnaces.

It is unwise to depend entirely upon any system of ventilation to overcome the powdered coal dust hazard. It is practically impossible for the air currents produced by the ventillating apparatus to penetrate the angle and corners of the building where the dust is liable to settle.

In examining storage bins and other places where coal dust may exist, an electric light should be used for illuminating purposes instead of an open light. As a further precaution, the electric bulb should be protected by a wire guard to prevent breakage, as there is a possibility that a cloud of coal dust can be ignited by the red-hot carbon filament of an incandescent lamp. Care should be taken to see that the wire is properly insulated so that an electric arc will not be caused.

To obtain the best results, as regards safety, in the use of pulverized coal as a fuel in industrial plants, it is important that both officials and men be educated to the idea that coal dust is explosive and therefore dangerous; and that under certain conditions it will ignite as readily as gas. The fact is not thoroughly understood and, sometimes at the cost of life and property is brought home to those connected with the operation.

He was rather the worse for liquor when he faced the magistrate, and it didn't require a rich brogue to indicate his ancestory. The remnants of a fighting Sunday jag left him very loquacious.

"What is your name?" asked the magistrate.

"Michael O'Halloran."

"What is your occupation?"

"Phwat's that?"

"What is your occupation? What work do you do?"

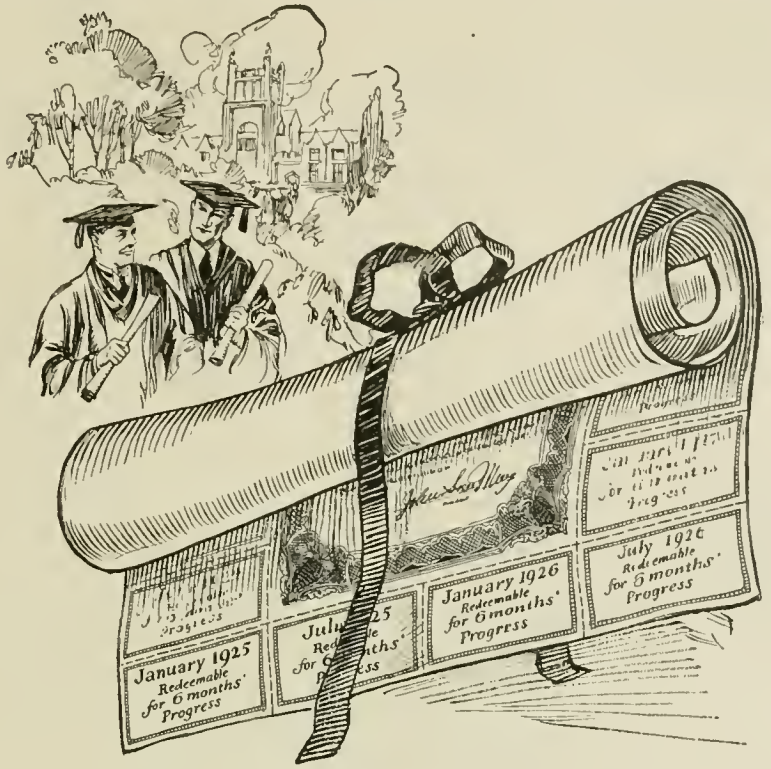
"Oi'm a sailor."

The magistrate looked incredulous.

"I don't believe you ever saw a ship," he said.

"Didn't Oi, thin," said the prisoner. "An phwat do yiz t'ink Oi cum over in, a hack?"

After that it went hard with Michael.



To you capitalists — the class of '24

Your college training is in truth a capital. Its value is not fixed, but depends on the way you invest it.

Some men demand a quick return — a high percentage of profit. Others look more to the sondity of the investment.

The man of speculative mind may stake all on the lure of a high starting salary, without a thought to the company which gives it or where this may lead him in ten years. True, his opportunism may reap exceptional profit; or else a loss.

The man who knows that great things develop slowly will be content with six months' progress in six months' time — provided he is investing that time in a company which offers him a future.

You who are about to invest, satisfy yourself that the security you are getting is gilt-edged.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

Since 1869 makers and distributors of electrical equipment

Number 43 of a series

The History of Surveying Instruments

(Continued from Page 191)

lowed out to receive a compass needle, a line or meridian was drawn across the bottom of the compass box so that the instrument could be oriented, and a revolving pointer was provided for determining directions by sighting. The instrument was set up at each station, oriented, and the pointer set along some course. A mark was then placed in one of the wax circles along the edge of the pointer. The course was then measured and the length, together with the color of the wax and the character of the wark, was recorded. Lengths were determined by means of cords and a rod of a fathoms length. When applied to mine surveys, the data thus obtained was used in laying out the survey on the surface to full scale, and by means of the same instruments that were used in the underground survey. Thus the proximity of the mining operations to boundaries was known.

In connection with the unit of length, the following is not amiss. In an old work on surveying published by Jacob Koebel in the year 1570, this quaint passage is found: "A rood should by the right and lawful way, and in accordance with scientific usage, be made thus: Sixteen men, short and tall, one after the other as they come out of a church, should place each a shoe in one line, and if you take a length of exactly sixteen of these shoes, that length shall be a true rood"! It is surely a far cry from this, to the present day methods of the United States Bureau of Standards.

This period also marks the first authentic record of the invention of the plane table, for in the year 1590, Johann Prateorius, constructed an instrument which embraced every principle of the plane table as it is used today, including the tripod support, the compass sunk in one corner of the board, a device for measuring vertical angles, and an alidade with a graduated edge. Targets, rules, proportional dividers, and compasses as are used for drawing, were all provided. Undoubtedly this instrument was also the consummation of long years of development, but in view of the remarkable similarity between this early instrument and our modern ones, it seems fair to say that the invention of the plane table as we know it, can be properly ascribed to Johann Praetorius.

From this time, a rapid improvement of surveying instruments ensued, and it was of such a character to be properly classed as development of instruments very similar to those of today, and therefore a history of this development cannot be properly included in this paper. Mention might be made, however of the "nonius" which was superceded by the vernier, invented in 1631 by Captain Pieere Vernier; of the application of the telescope to surveying instruments; of the introduction of crosshairs into the telescope by Wiliam Gascoigne in the year 1640; of the use of the acheometric principle of sub-tense measurements by James Watt in 1770; but as before stated, these subjects belong really to the field of modern engineering, and cannot be properly treated here.

In closing it might not be amiss to give a sort of a conception of surveying practise as it existed at this time, and this can be best done by the quotation of significant writings which will allow the reader to form his own opinions. John Love, in the year 1744, in a work on surveying, made the following statements: "This instrument depends wholly upon the needle for the taking of angles, which often proves erroneous, the needle itself varying from the north even if there be no iron mines or other accidents to draw it aside which in mountainous lands are often found. It is therefore the best way for the Surveyor, if he possibly can, to take his angles without the help of the needle as is before shewed by the Semi-circle. But in all lands it cannot be done, and we must make use of the needle, as in the thick woods of Jamacia, Carolina, etc. It is good therefore to have an instrument which may take an angle with or without the use of the needle." And he further says, "I have taken Example of Mr. Howell to make use of the Table of Sins and Tangents, but only to every fifth minute, that being high enough in all Sense and Reason for the Surveyor's use, for there be no man, with the best instrument ever made, can take an angle in the field, nigher, if so nigh, as to five minutes."

In the light of these statements, it behooves the modern surveyor and engineer to be careful in *his* statements of the great accuracy in measurement to which we are able to attain, or statements of things to which we will not be able to attain. Civilization marches onward, regardless of what Man says of it. And we should humble our minds and cease our loud boastings of our present day wonders, when we see that the very principles and instruments of which we so loudly boast, were used long ago and were even forgotten during the lapse of the ages.

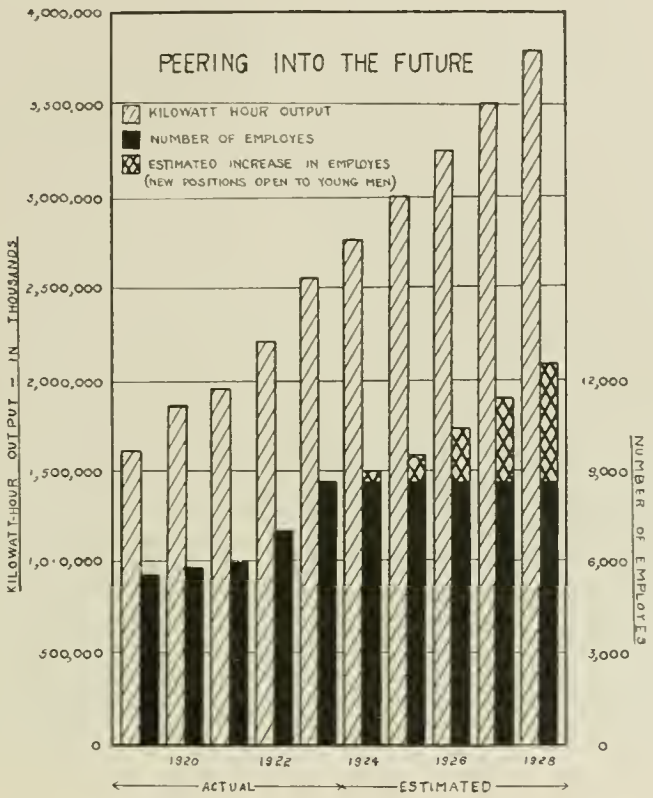
A WORD TO THE WISE

"Professor," said the graduate trying to be pathetic at parting, "I am indebted to you for all I know."

"Pray do not mention such a trifle," was the reply.

"Discord am horrible," said the musical darky as he was about to be hung.

COMMONWEALTH EDISON COMPANY



THE Commonwealth Edison Company of Chicago is the world's largest steam electricity supply company. Its constant growth offers opportunity to the young men who become associated with it. The above chart shows the probable growth in output and in number of employes over the next five years. It indicates that 3,856 additional employes will be added to the payrolls.

An analysis shows that the ratio of supervisory positions in the Company is one for every eight employes. On this basis, during the next five years, there will be 480 additional supervisory positions open to those now in the organization, or those who come into it. These figures are conservative, as no allowance is included for replacing those who leave the Company's service.

The number of employes on January 1, 1924, was 8,642, compared with 7,098 the year before. Of this number, 2,494 had been with the Company five years or more; 688, ten years; 357, fifteen years; 172, twenty years; 79, twenty-five years and 51, thirty years, or more.

Graduates of Mechanical and Electrical Engineering courses are taken into the Company through the Chicago Central Station Institute and are given an opportunity by working in many of the departments of the Company to make a study of the business. Not only do young men obtain a broader training through this method, but they are enabled to find the place in the Company most suited to their capabilities or liking.

Commonwealth Edison Company

Edison Building, 72 West Adams Street, CHICAGO

College Notes

(Continued from Page 199)

boots, and registers in any combination and under varied conditions. Two tables give the tabulated results of the tests; those of the Piped Furnace Plant being given in detail in the thirteen page table 2, while the results of the tests on the auxiliary plant are given in tables and figures 8 to 17. A discussion of all results is included in the chapters IV to XXI.

A very brief summary of the more important results is as follows: A comparison of the performance of the same furnace operating with anthracite and bituminous coal showed that within practical combustion rates, the anthractite coal gave higher capacity and efficiency than the bituminous coal for the same combustion rate; at combustion rates that are excessive for warm-air furnace practice, however, the reverse was true. Also, bituminous coal gave a more nearly constant efficiency over the whole range of combustion rates than did anthracite. At any given combustion rate more draft was required to operate the furnace on anthracite coal than on bituminous coal.

A test of two different types of furnaces showed that the efficiency of the steel furnace was more nearly constant and also higher than for the cast-iron circular-radiator furnace, over the whole range of combustion rates. The crescent-radiator furnace also proved better than the circular-radiator furnace. Also the tests indicated that the cylindrical bonnet with side outlets was the most satisfactory of those tested. It was proven, too, that the round duct with 45-degree elbows and without unsatisfactory right-angle turns of the rectangular duct was far the best, handling a greater volume of air and developing a greater heat at the registers. A rather interesting fact discovered was that while register grilles apparently did not affect the capacity of air of the hot air ducts, yet the removal of the grille in the cold-air register increased the capacity 4 per cent at moderate temperatures.

The results of the tests allow the calculation easily of the proper size and design of the furnace heating system of a house. It greatly simplifies proper design.

"The rapidly increasing divorce rate," remarked the newcomer, "proves that America is fast becoming the land of the free."

"Yes," replied his friend," but the continuance of the marriage rate shows that it still is the home of the brave."

"Eat-Mor" (bulk) and "Tak-Homa-Brik" (brick) are

Ice Cream Favorites

They have a richness of taste that makes them a favorite among many. Serve one of them at your next party. Remember, "You'll Favor the Flavor."

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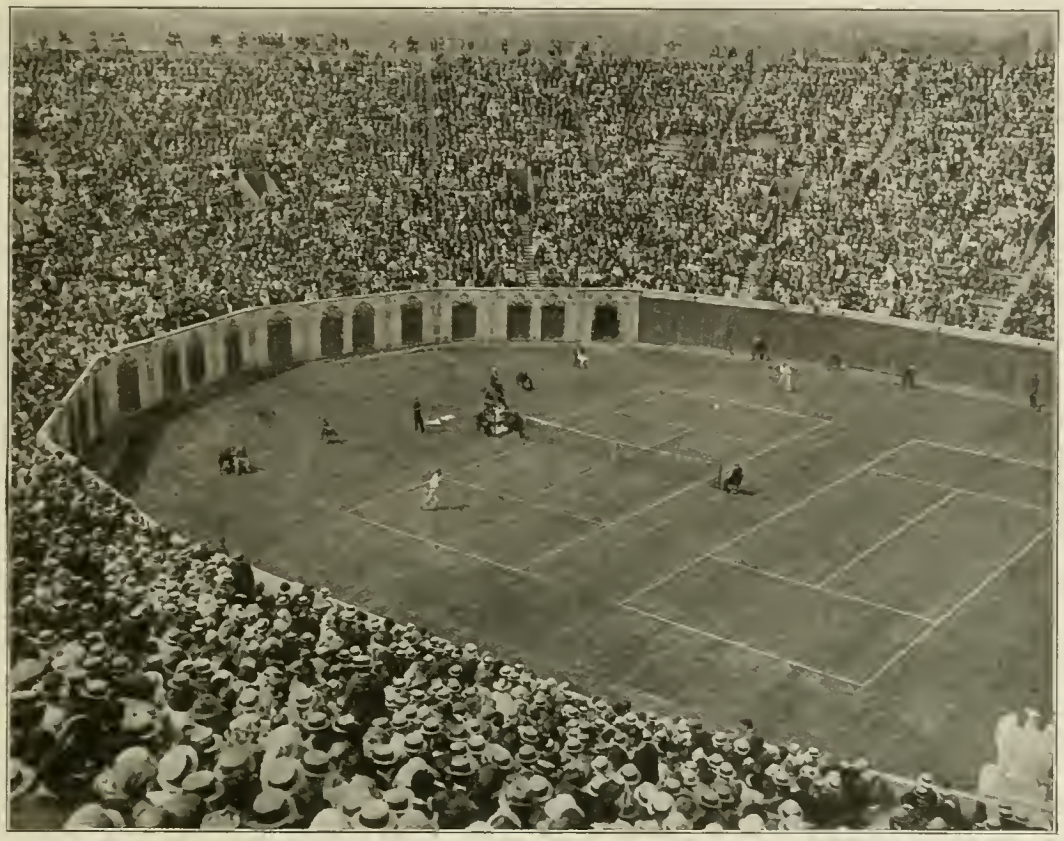

THE WEST SIDE TENNIS CLUB STADIUM, FOREST HILLS, LONG ISLAND
DURING THE DAVIS CUP MATCHES
KENNETH M. MURCHISON, ARCHITECT CHARLES S. LANDERS, ENGINEER

AMERICA'S Tennis Stadium at Forest Hills, Long Island, was built by The Foundation Company in record time. It was begun in April and completion was promised for the Davis Cup Challenge Round on August 31, 1923. It was actually used for the Women's Nationals on August 13. The West Side Tennis Club, in choosing a general contractor, selected The Foundation Company because its record guarantees trustworthy workmanship and speed of construction without sacrifice of economy.

The Foundation Company is an organization of construction engineers specializing in the building of difficult superstructures and substructures. The world-wide reputation gained in its early history for trustworthy underground construction has followed it into the field of general engineering contracting. Among the structures completed by The Foundation Company are *buildings of every known type.*

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CHICAGO	SAN FRANCISCO	LIMA, PERU	LONDON, ENGLAND
PITTSBURGH	LOS ANGELES	CARTAGENA, COLOMBIA	PARIS, FRANCE
ATLANTA	MONTREAL	MEXICO CITY	LOUVAIN, BELGIUM

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

Research Residence

(Continued from Page 189)

both for 4-inch and 6-inch studs; (c) offset stacks and fittings; (d) what effect has height on stack capacity?; (e) the value and importance of insulation.

(10) Effect of installation details on leaders, or warm air pipes in the basement.

(a) Pitch or grade of basement pipes; (b) short and long runs; (c) friction caused by elbows in leaders which cannot be run straight; (d) the value and importance of insulation.

(11) Relative value of an inside chimney which runs up through the center of the house compared with an outside chimney at the end of the house. In each chimney there should be one fire clay tile-lined flue and one plain brick flue. What allowance in draft should be made when an outside chimney must be used? Does the flue lining pay?

(12) Effect of maintaining constant temperature day and night as opposed to normal temperature by day and lower temperature at night.

(13) The case of the remote room with three sides exposed, and the room in the attic demand special study. Can the former be dealt with successfully by using larger leaders and stacks, or should it be equipped with storm windows or metal weather strips? The attic room should be easy to heat if we know the correct heat loss. What are the losses from such rooms and how computed?

(14) What should be done with a sun porch? Can it be heated along with the rest of the house? Should it have a separate return air duct?

Finally, the house will afford a most unusual opportunity to check up many of the requirements of the new Installation Code, and most important of all, it will provide a positive means for securing check data on the total heat loss from a house as well as from the individual rooms.

To accomplish these objects the residence will be elaborately equipped with instruments both recording and indicating for the measurement of temperatures, air quantities and velocities, humidity, wind movement and direction, fuel consumption and waste. Much of this equipment must be installed as the construction progresses and will become an integral part of the structure. When completed the residence be will not only a thermal testing laboratory but a calorimeter in itself.

It is planned to furnish the house and to have it occupied so that the conditions prevailing in actual residences will be duplicated insofar as is possible. The residence will be open to visitors at hours to be established later. Actual testing work will begin with the opening of the heating season in the fall of 1924.

Engineers' Day

(Continued from Page 183)

three, namely, J. Robert Welsh, c.e., '24, in charge of the convocation; A. G. Dixon, gen.e., '24, in charge of the dance; and H. E. Wessman, c.e., '24, in charge of the parade. It is to these men, who joined in unselfish, co-operative effort, that the successful inauguration of Engineers' Day is due.

In reviewing the celebration, credit is given to the members of the various departments for work done in assembling their respective floats, the subcommittees for carrying the program through on time and complete, and to members of the faculty who advised and spurred the students to "carry on."

It is hoped that in succeeding years other features may be added to the Day;—that certain engineering events, such as the Engineering Open House may be combined with these other events,—and thus establish Engineer' Day as an honored and necessary University custom and precedent, in order that the college of engineering may maintain, even deepen, this new spirit of loyalty and fraternity so well begun.

We have given Clothes Satisfaction to 5 generations of students. And all the time our reputation for good service has increased.

Jos. Kuhn & Co.

33-35-37 Main St. Champaign

"A-B-C-stuff"

In college a fellow is handed a mass of facts—some of them simple and fundamental, others complex, intricate and hard to remember. *Get your fundamentals fixed* and it won't often be serious later if you have to seek a reference book for the complexities.

For instance, it is easy to grasp once and for all time the fundamental of good paving—*THE "ABC" PAVEMENT*—

Asphalt *for* Filler
Brick *for* Surface
Crushed rock, gravel, Crushed slag or Concrete *for* Base

Why the "ABC" pavement is right for city streets, country highways, railroad yards and factory floors and drives is told briefly and pointedly in the side panel.

ASPHALT for *Filler* because it makes the traffic-bearing surface a water-proof, flexible armor not subject to the cracks which follow rigid slab construction, and because repair costs are insignificant where each brick is an easily removable unit.

BRICK for *Surface* because it furnishes the best surface for traffic; *hard*, but not brittle—*tough*, but not rough—*dense*, and non-absorbent—*smooth*, but not "slick;" because its fire-hardened toughness resists wear and tear so sturdily that upkeep expense is squeezed to a minimum and because any margin of higher first-cost is speedily offset by low maintenance, long life and uninterrupted service.

CONCRETE, CRUSHED ROCK, CRUSHED SLAG OR GRAVEL for *Base* because some one of these bases meets any conceivable sub-soil condition, and with a bedding course of sand or screenings makes the best sub-structure yet developed for modern street or highway traffic.

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ENGINEERS BUILDING CLEVELAND, OHIO

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PAVEMENTS Outlast the Bonds

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AMERICAN SHEET AND TIN PLATE COMPANY, Frick Bldg., Pittsburgh, Pa.

Anaconda Reduction Works

(Continued from Page 176)

arsenic fumes are now recovered by the Cottrell electrical precipitation method near the foot of the stack, and it is this arsenic which is the main source of supply for the United States.

Lately, a sulphuric acid manufacturing plant has been built which uses the gases from the roasting plant as its source of supply. The Glover and Gay-Lussac method is used. Large scale production has made for low costs and has developed this subsidiary operation as a profitable by-product.

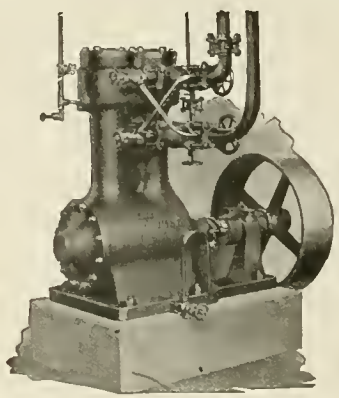
An abundant water supply is one of the most important needs of an ore reduction works, and it was this that led to the selection of Anaconda, instead of Butte, as the site for this plant. The present consumption of water exceeds 60,000 gallons in 24 hours, and this supply must be transported from Warm Springs Creek through a wooden flume that follows the hillsides for a distance of eight miles.

Another, almost equally as important, need is compressed air. Nearly five million cubic feet of free air, weighing about two hundred tons, is compressed every 24 hours. It is used at pressures varying from 900 pounds per square inch for the air locomotives to one pound per square inch for the reverbatory furnaces.

The electrical power consumption for such a plant is necessarily great. Twenty thousand electric horse power is received from the water-power plants of a subsidiary company, coming in at 92,000 volts and transformed to 2,200 volts for the larger motors. Another 10,000 horse power is developed in steam engines of which 80 per cent of the steam supply comes from waste-heat boilers. The largest consumer is the main power station which uses 15,000 h. p. for air compression. The next largest is the concentration process which uses 12,000 h. p.

The research laboratories of this plant are the

(Continued on Page 218)



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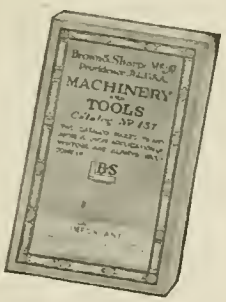
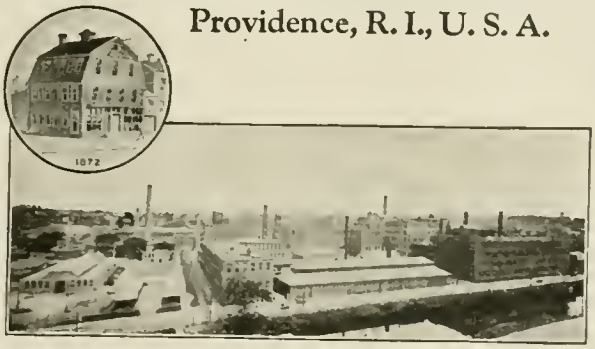
Knowledge of our line of manufacture will surely be of use to you in years to come—for Brown & Sharpe Machines are used in a great many industries. In the small repair shop or in the largest high production manufacturing plant, these machines are being used to do many classes of work. The small shop likes their versatility and ability to stand up under that extraordinary job which often loads the machine beyond its rated capacity. The big plant finds they give production and a product uniformly accurate. Brown & Sharpe Machines are ruggedly constructed and will maintain their accuracy for many years. Investigate their many uses.

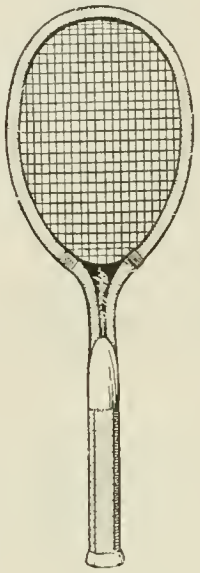


Ask your Librarian to show you the Brown & Sharpe books — Catalogue studies—Nos. 29, 29x and 29xx. Our Catalogue No. 137 gives details about our entire line of manufacture.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.



Bailey and Himes
ATHLETIC EQUIPMENT



Tennis Rackets—17 models of them and a good selection in each model.

Tennis Balls—

Wright and Ditson
50c

Spalding
50c

STUDENT SUPPLY STORE
Service Saving Satisfaction
606 East Green St.
"Chuck" Bailey Shelby Himes

(Continued from Page 216)

last word in the metallurgical world. Four Illinois graduates are employed in this department to aid in discovering and developing new processes and improving those now in practice at the Reduction Works. These laboratories receive 6,500 samples and make 16,000 chemical determinations every month.

There is a noticeable lack of men about the plant, the 2,700 employees being lost in the maize of shops and mills. This condition is possible because of the high development of mechanical and automatic devices. Included in the above 2,700 are 240 men comprising the supervising force, a technical staff of 60 metallurgists, civil, and mechanical and electrical engineers, and a general accounting staff of 100 men and women. During the past six years the company has spent more than $100,000 in Anaconda to provide 'safeguards,' safety appliances, and the promotion of the safety habit among its employees.

US POOR MEN

Alice for the first time saw a cat carrying her kitten by the nape of its neck.

"You naughty cat!" she cried, "you aren't fit to be a mother! You ain't hardly fit to be a father!"

WICKES
VERTICAL
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Wickes Vertical Water Tube Boiler

Air infiltration losses in a boiler setting is one of the big and preventable losses in boiler room operation.

The steel cased setting enclosing the WICKES boiler prevents air infiltration losses, and the highest possible thermal efficiency results.

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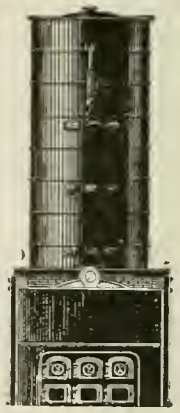

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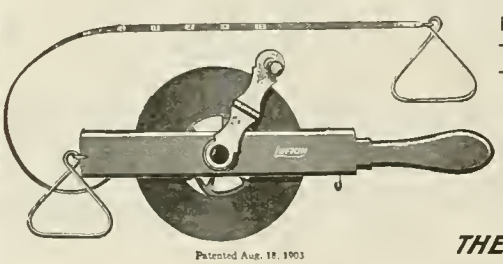

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FROM SURVEYS TO FINISHED CONSTRUCTION AND INSPECTION WE HAVE PATTERNS BEST SUITED TO EVERY PURPOSE

Stocked by Hardware and Engineering Supply Houses.

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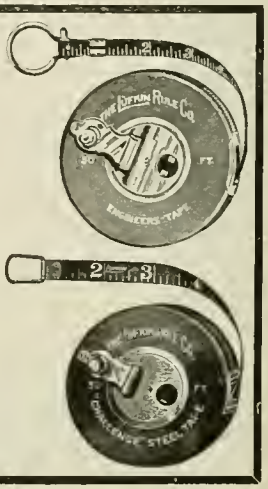


THE LUFKIN RULE CO. SAGINAW, MICH.
New York, London, Eng., Windsor, Can.

EXPLETIVES INTERESTING

An irate colonel was being followed by a solitary spectator during his round of golf. At last he could contain himself no longer, and he explosively exclaimed, "What the blazes are you looking at?"

"I'm not looking," was the reply. "I'm listening."

NATIVE PRIDE

"You say you came from Detroit," said the areveler to his fellow passenger, "that's where they make automobiles, isn't it?"

"Sure," said the Detroiter with some resentment, "we make other things in Detroit too."

"Yes, I know," retorted the other, "I've ridden in 'em."

AND NO WONDER

There was a young person named Ned,
Who dined before going to bed
On lobster and ham,
And salad and jam,
And when he awoke he was dead.
—*Woman's World.*

DAUGHTER'S LETTER HOME

"My daughter at college writes me that the Purity League there had a parade for all students who had never kissed a girl."

"How did it turn out?"

"One of the fellows took sick and the other wouldn't march alone."—*Washington Columns.*

KEEN COMPETITION

Mary's beau (waiting for her to come down stairs) "Is Mary your oldest sister?"

Kid Brother: "Yep."

Mary's Beau: "And who comes after her?"

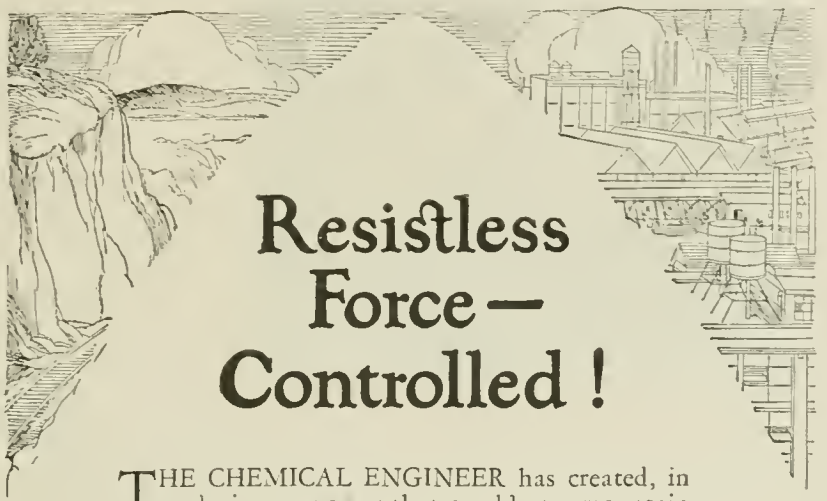
Kid Brother: "You and two other guys."—*Lehigh Burr.*

REPOSE

Child: "Mother, who put the statue under the kitchen sink?"

Mother: "Sh! Sh! That's the plumber."

G.R.GRUBB & CO.
ENGRAVERS
CHAMPAIGN,
ILLINOIS.



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THE CHEMICAL ENGINEER has created, in explosives, a power that can blast a mountain or crack a boulder—dig an isthmian canal or drain a swamp.

Today, explosives power is employed both in the heaviest and in the most delicate operations. The scientific control of this resistless energy has enabled explosives engineers to utilize it in ways undreamed of a generation ago.

Recently at the Frazier Quarries of the Chesapeake & Ohio Railroad in West Virginia, 60,000 pounds of du Pont dynamite were exploded at one time to bring down *five hundred million pounds* of stone for ballast. Literally a whole hillside was blasted out.

But in a power house in Baltimore, du Pont explosives were used to perform a different and delicate operation. This work involved blasting out five concrete bases in the basement of the building without damage to a switchboard that governed the distribution of power over a large section of the city. While blasting was in progress a glass of water and some wire nails placed on their heads in an upright position near the blasts were not disturbed by the explosions.

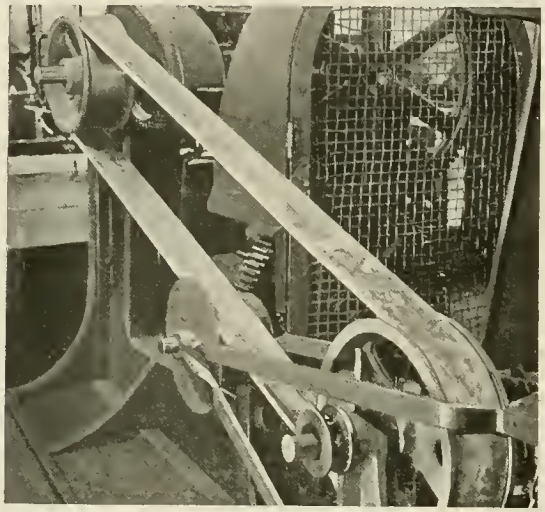
So, to dynamite, we have a servant that will do our bidding in little things as well as big—a power that can be made to perform our work easier, better and cheaper in all industries.

The du Pont Company has been making explosives since 1802. With the development in explosives manufacture have come many improvements to expand the use of the product. And it has been the privilege of du Pont, through exhaustive research and experiment, to lead the way.

E. I. DU PONT DE NEMOURS & CO., Inc.
Explosives Department, Wilmington, Delaware

DU PONT
EXPLOSIVES

RHOADS' Tannate Leather Belt



It Slips. Yes! —But Its Grip Saves It.

ON this wire-rope stranding machine, at one stage of the winding it is necessary for the belt to slip; then it must pick up the load promptly or be badly burned.

This Tannate Belt slips enough to meet the tension; and as the strain passes, picks up the load at once.

Other belts burned and broke after two or three weeks' use. This Tannate belt was "good as ever" at the end of six months' service.

It is a common thing for Tannate Belts to have steady overloads of 20% or 30%; and instances of short loads 100% to 130% above normal are not unusual. And this is done at a comparatively moderate slip. Most belts would not stay on the pulleys at all.

In plants where loads fluctuate, the value of this capacity of Tannate for overloads is very great indeed.

Rhoads Tannate Lace Leather out lasts Rawhide three to five times and sometimes longer.

J. E. RHOADS & SONS

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Summer Work

(Continued from Page 180)

engineering work has varied, a low point being reached in 1921 a year of industrial depression. However, since that time the curve has steadily gone up and reached a higher point in 1923 than at any time previously reported. The small group that attend school or summer camp has also been decreasing.

All of the advantages to be derived from working in one's future field of endeavor need hardly be mentioned, but there are a few that are not always thought of. The chief of these is the possibility of finding some particular company or line of work that you are interested enough in to desire to return to after graduation. Although there are no figures available relative to the number of men who return to the companies for whom they have worked during previous summer vacations, it is known that the number is large. Probably the most attractive feature of this, to the average undergraduate at least, is that these men are able to obtain better positions right from the start. It is not necessary for them to go through the preliminary training that they have assimilated during the summers, and the result of being able to eliminate this is obvious. Then again the company will not employ the man after graduation unless his previous work has been satisfactory. They are able, during the summers, to judge the capacity of the man and if they want him to return to them he can be reasonably sure that there is something ahead for him in that organization.

This has not been an attempt to justify or extoll the value of summer work for the beginner; but rather to bring to the readers' attention how closely the engineer and summer work have become allied. Figures usually speak for themselves, at least for the technical man, and in this case they speak clearly. There must be a great deal of value to be obtained by spending the three months between the closing and the opening of the school year in some line that will give one practical experience in the field that he has been studying for nine months, or there would not be such a large majority so occupied. The committee is anxious to place every engineer in some kind of engineering work, and it is believed that every engineer who desires such a job will have his wishes granted by getting in touch with the Committee on Summer Employment.

HOORAY FOR '27

Co-ed: "Your new overcoat is rather loud."

Frosh: "It's all right when I put on a muffler."

P. F. WALKER, Dean of the Engineering School of the University of Kansas

Why do so few engineers win to the top

—*while so many are lost in the crowd?*

AN IMPRESSIVE FIGURE in the field of technical education is Dean P. F. Walker, head of the Engineering School of the University of Kansas.

With keen personal interest Dean Walker has watched the progress of the engineers whom he has trained. And he has noticed that in a very short time after their graduation they have separated themselves into two distinct groups.

The majority, adding nothing to their technical training, have gradually settled down into the rut of a specialized job.

The others have come to realize that without business training, technical training carries a man just about so far, and no farther.

But how can a technical man secure the distinct and profitable advantage of business training? The best answer to that question which Dean Walker has been able to find is the Alexander Hamilton Institute.

In a recent letter he wrote:

On this page, Dean Walker answers the most pressing question that challenges the young engineer graduate today.

The danger of specialization

"For the young engineer who has left school and gone into some position where his time is filled with technical matters associated with his job, it is of the utmost importance that the Business Course of the Alexander Hamilton Institute should be brought to his attention.

"From my own past experience I know there is a tendency to let down and to perform only the routine work called for on the job. This is the most dangerous thing that can befall a young engineer graduate. The Modern Business Course becomes a continual challenge and stimulus, impelling him to go on with his work in lines that will supplement the technique of his engineering job. *I recommend it without qualification to all men who graduate from this school.*"

Rather a startling statement, coming from such a man, isn't it?

But put it to the proof yourself. Look about you, and in case after case you will find the specialist in a subordinate position, while at the head of the business is a man who may know less about each department than the department heads, but *whose all-round knowledge of business fits him to direct their activities.*

What the Institute does

When Mr. T. H. Bailey Whipple was Director of Education for the great Westinghouse Electric and Manufacturing Company, he said:

"I know of no other preparation that equals your Course for fitting a man to grasp his opportunity and succeed in it when it comes.

"If conscientiously pursued, your Course, coupled with one's daily problems and activities, unquestionably does for men what experience and native ability alone can never do."

In a few words, this is what the Institute does:

It takes a man in any department of industry, technical or clerical, and gives him a working knowledge of all the other departments. In a few months of interesting reading, it gives him a conception and understanding of business as a whole which ordinarily he could gain only after years of actual experience. Automatically it lifts him out of the class of men of which there are too many, into the class of which there are too few.

Send for this book

Technical men find much that is interesting and valuable in the Institute's descriptive book, "A Definite Plan for Your Business Progress." It gives all the facts about the Modern Business Course and Service, and tells what it has done for over 20,000 other technical men. Moreover, it contains an interesting chart whereby you can measure, by weeks and months, the future advancement which *you* can attain.

This booklet will be sent you gladly, and without the slightest obligation. If you have ever asked yourself, "Where will *I* be ten years from now?"—send for it.

This coupon will bring you the facts

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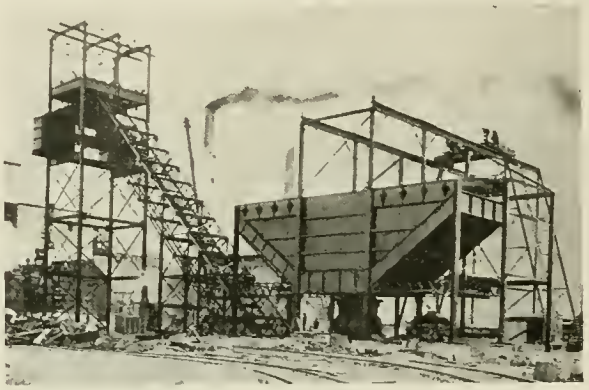

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August Zeising

(Continued from Page 181)

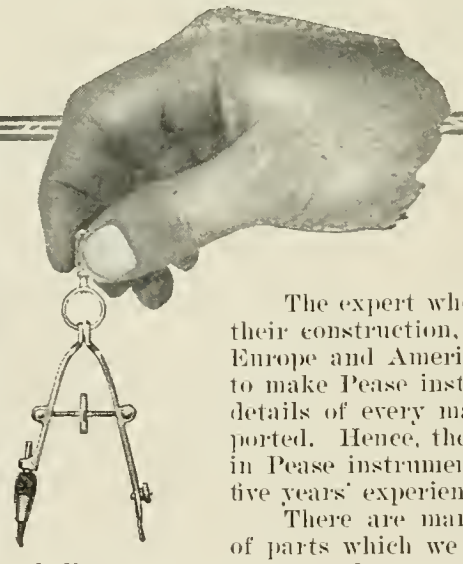
Ambridge and Pittsburg, Pa.; Trenton, N. J.; Baltimore, Md.; Detroit, Mich.; St. Louis, Mo.; Canton and Toledo, Ohio; Salt Lake City, Utah; Wilmington, Del.; Gary, Ind.; Elmira, N. Y.; Chicago, Ill.; and Pencoyd, Pa.

The products, if bridges may be considered as such, include the Williamsburg bridge over the East River between New York and Brooklyn; the Mississippi river bridge at Thebes, Illinois; the Harve de Grace bridge at Perryville, Md., over the Susquehanna river; the Emergency Dam, Panama Canal Zone; the great ore dock at Two Harbors, Minn.; the Seneca river bridge Savannah, N. Y.; the "Hot Metal" bridge at Port Perry, Pa.; the Hudson river bridge at Poughkeepsie, N. Y.; the Niagra Arch bridge replacing the old cantilever bridge; the Rondout Creek bridge south of Kingston, N. J.; and the Hell Gate bridge, New York City, which is the longest arch bridge in the world.

HAVE IT YOUR OWN WAY

Gym teacher (to girls): "Lot's of girls use dumb-bells to get color in their cheeks."

Bright girl: "And lot's girls use color on their cheeks to get dumb-bells."



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There are many equally important features such as interchangeability of parts which we would like to tell you about. Literature and prices will be gladly sent on request, and your money will be promptly refunded if you are not completely satisfied with Pease drawing instruments after using them.

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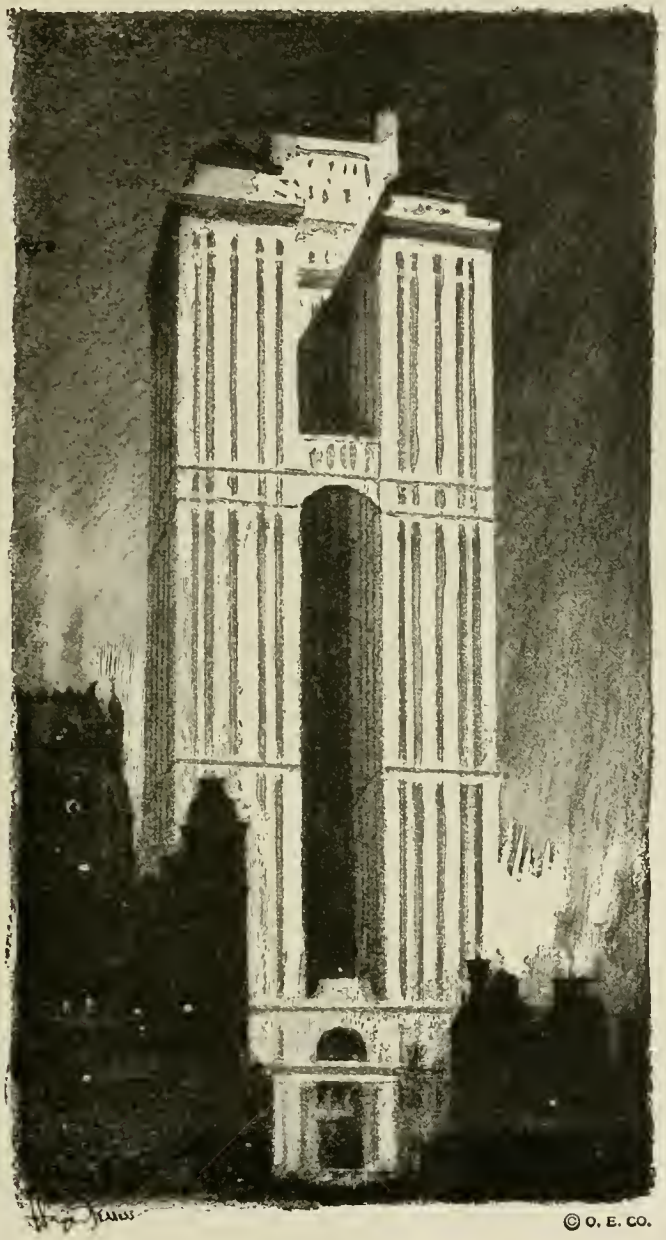

The Magnolia Petroleum Building, Dallas, Texas
ALFRED C. BOSSOM,
Architect

Drawn by Hugh Ferriss

"Sheer Height"

THE American business building represents a distinct and national architectural style when its design frankly emphasizes its sheer height and outwardly expresses the inner facts of its construction.

The tall buildings which stand as monuments throughout the country to the vision of our architects and the skill of our engineers have, in the gigantic profiles which they rear against the sky, the true American spirit of aspiration and progress toward even greater achievements.

Certainly modern invention—modern engineering skill and organization, will prove more than equal to the demands of the architecture of the future.

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Offices in all Principal Cities of the World

HENRY CAVENDISH
1731-1810
English chemist and physicist, of whom Biot said, "He was the richest of the learned and the most learned of the rich. His last great achievement was his famous experiment to determine the density of the earth.

He first made water from gases

Henry Cavendish, an eccentric millionaire recluse, who devoted his life to research, was the discoverer of the H and the O in H_2O. In fact he first told the Royal Society of the existence of hydrogen.

He found what water was by making it himself, and so became one of the first of the synthetic chemists.

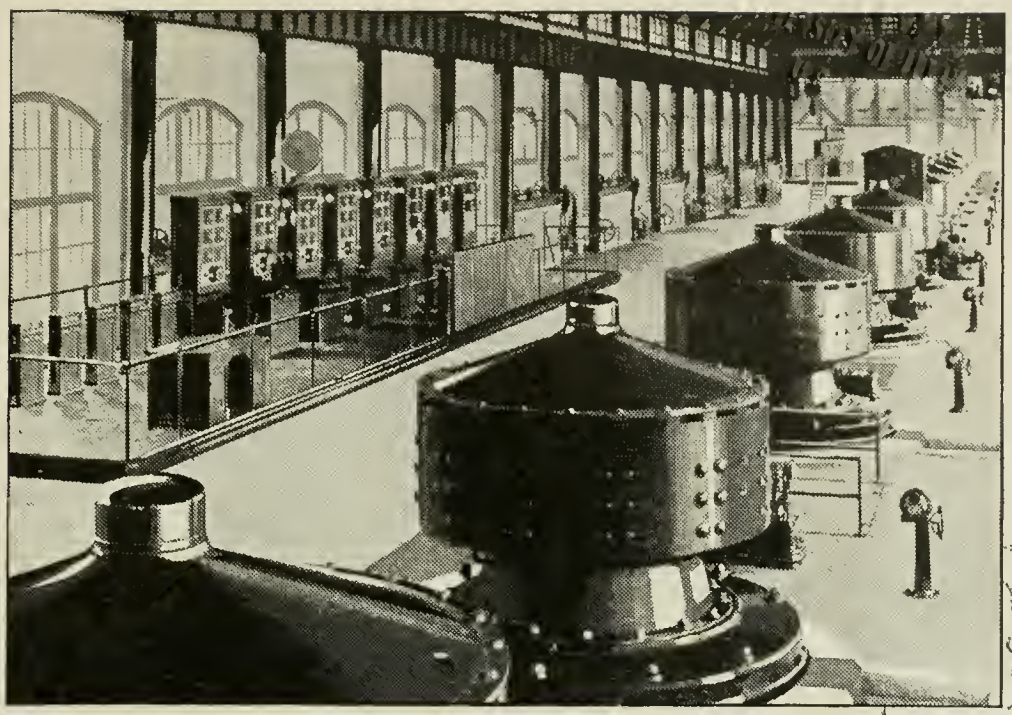
Cavendish concluded that the atmosphere contained elements then unknown. His conclusion has been verified by the discovery of argon and other gases.

The Research Laboratories of the General Electric Company have found a use for argon in developing lamps hundreds of times brighter than the guttering candles which lighted Cavendish's laboratory.

In this age of electricity the General Electric Company has blazed the trail of electrical progress. You will find its monogram on the giant generators used by lighting companies; and even on the lamps and little motors that mean so much in the home. It is a symbol of useful service.

GENERAL ELECTRIC

Harnessing Niagara Falls for the First Time



What Engineering Owes to Faith

THE pioneer harnessing of Niagara Falls in 1892, like all great engineering feats, was the result of the co-operation of many able and constructive minds. There were no "older engineers" on this work, with younger assistants, as is now common, because there were no "older" engineers then. All of them were young men in a young business, optimistic, enthusiastic and willing to take long chances.

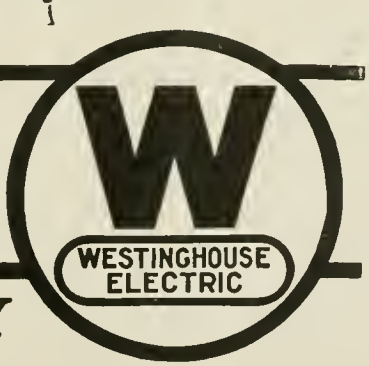
The original Niagara installation represented progress based largely on faith because there were many features of construction proposed at that time which Westinghouse Engineers refused to accept, and which time has shown to be utterly impracticable.

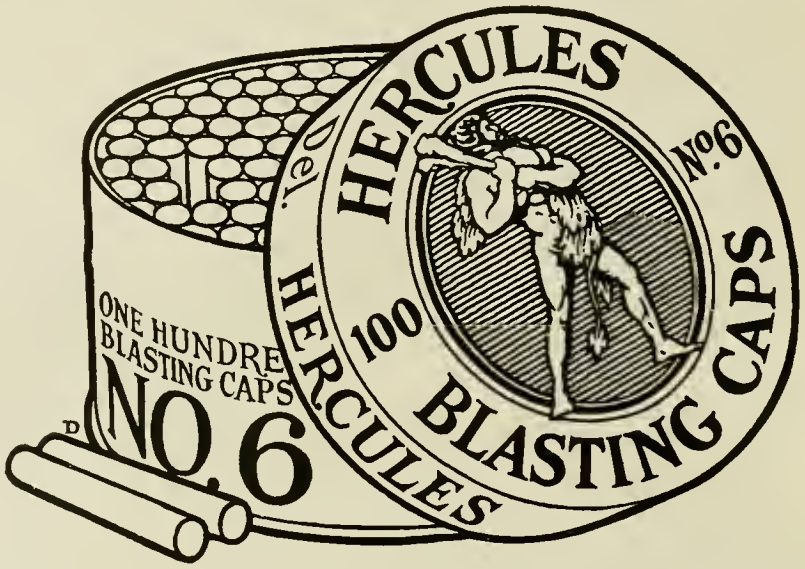
Thus, in effecting a compromise, the three fundamental features of *heating*, *insulation* and *regulation* of the 25-cycle machines as built, were vastly different from the original designs. Time verified their judgment, the ten original generators operating successfully for more than a quarter of a century.

Looking back, it is gratifying that those young men served engineering so courageously, because truly it was an undertaking that taxed their faith to the limit.

Westinghouse

ACHIEVEMENT & OPPORTUNITY





To Help You to Decide

THE manufacture of 100,000,000 blasting caps without a complaint, and 20,000,000 electric blasting caps with only one valid complaint involving a small number, is the present record of our Port Ewen plant. It is a record of which we are not ashamed, and which we are naturally striving to maintain; but after all, the record itself is not the important thing to our customers.

In any process which involves the human factor largely, as does the manufacture, inspection, and testing of blasting caps, perfection is unattainable. The nearness to which it can be approached depends upon the skill and conscientiousness of the workers; and upon the vigilance with which checks are applied by persons, themselves liable to error, upon the performance of others subject to the same liability. This practically perfect record of ours for a certain period should interest customers only as it indicates that our force is able and careful, and that our supervising and testing are accurate.

When a manufacturer can say this, it is difficult truthfully to say more. It then becomes merely a question of degree; for ability, and carefulness, and accuracy are relative terms. We wish it were possible to take all of you who use blasting caps or electric blasting caps through our plant so that you might decide at first hand how far we have traveled towards the impossible goal of pefection in manufacturing. This is not practicable, but to assist you to form your own opinions of this, in succeeding advertisements we shall go behind our record of performance and describe some of the means we use which made the record possible.

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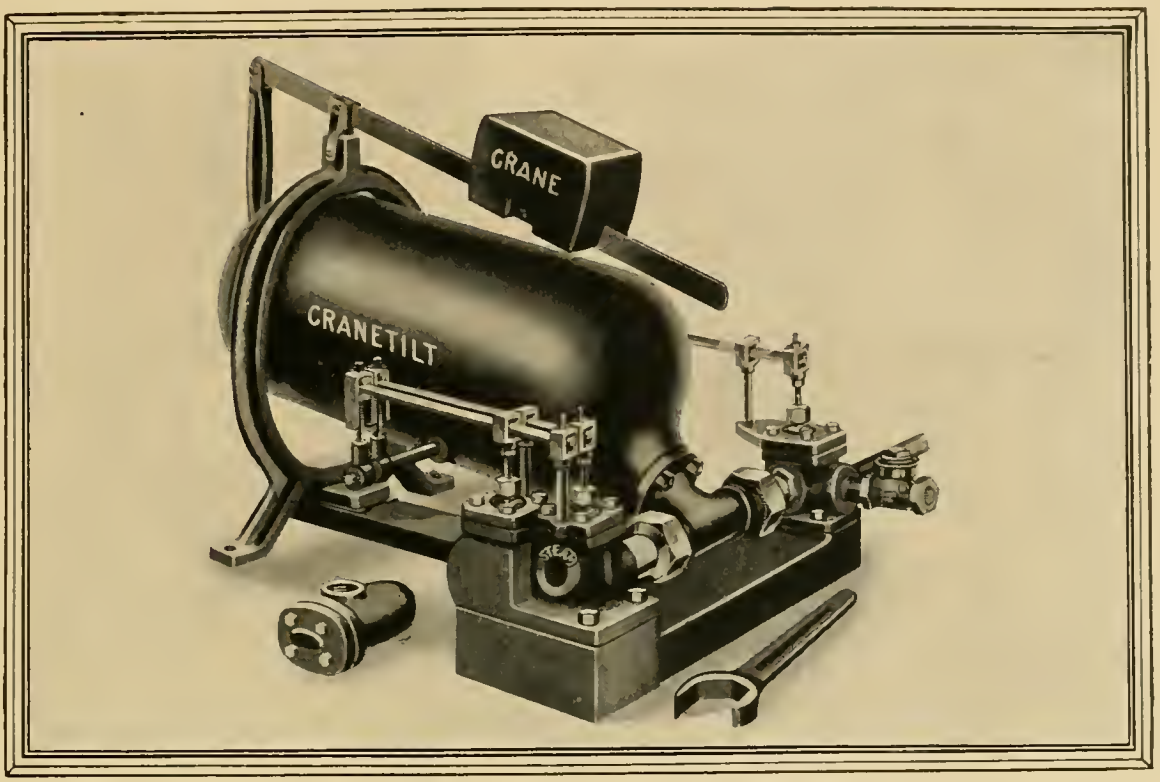

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Write for your copy of "Condensation," Crane booklet No. 164, which gives you many useful facts about the installation and care of steam traps.

This 54-page booklet contains valuable information about the use of steam traps. Write Crane Co., Chicago, for a copy.

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Their design is inherently adapted for Dual-Duty — the carrying of radial loads *and* thrust loads *and* resultant loads simultaneously. By taking advantage of this multiple ability of Timkens the designing engineer avoids much more complicated construction otherwise needed to do the work. With Timkens he immediately reduces the number of parts and consequently he eliminates excess weight.

And since the Timken principle also permits greatest load to be carried per unit of space required, Timken mountings are most compact, so that housings are smaller.

When any one housing or unit may be made smaller and lighter, all related parts in turn may be similarly refined. Thus Timkens, in themselves a refinement, favorably influence the entire mechanism in which they are used.

And Timken influence in bettering a machine never ceases, because when that wear which eventually *must* follow motion does come, its deteriorating effects need not be tolerated in Timken-equipped mechanisms. Timkens can be *adjusted* to function as when new.

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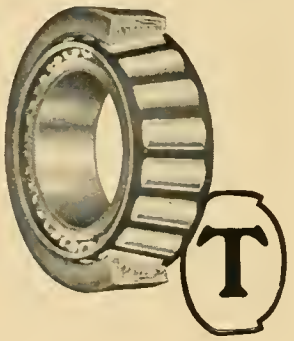

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